Division of Measurement Standards
8500 Fruitridge Road
Sacramento, California 95826-4808

March 20, 2003

TO WEIGHTS AND MEASURES OFFICIALS

The enclosed revised pages for the Field Reference Manual incorporate the most recent applicable changes to the California Code of Regulations, Title 4, Division 9.

Please remove and insert pages as follows:

Remove Pages	**Insert Pages**
D2-8A to D2-12	D2-8A to D2-12
D2-27 to D2-32	D2-27 to D2-32B
D2-47 to D2-50	D2-47 to D2-50
D3-7 to D3-14	D3-7 to D3-14
D3-17 to D-20	D3-17 to D-20
D3-31 to D3-34	D3-31 to D3-34
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D3-45 to D3-46	D3-45 to D3-46
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D3-57 to D3-58	D3-57 to D3-58
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Sincerely,

Mike Cleary
Director
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Enclosures

This requirement does not apply to complete scales and weighing elements which satisfy the following criteria:

(1) The device has been evaluated for compliance with T.N.8.1. Temperature under the National Type Evaluation Program (NTEP);

(2) The device has received an NTEP Certificate of Conformance; and

(3) The device must be equipped with an automatic zero-setting mechanism which cannot be made inoperative in the normal weighing mode. (A test mode which permits the disabling of the automatic zero-setting mechanism is permissible, provided the scale cannot function normally while in this mode.)

(Added 1993) (Amended 1996)

S.6. Marking Requirements. [See also G-S.1., G-S.4., G-S.6., G-S.7., G-UR.2.1.1., and UR.3.4.1.]

S.6.1. Nominal Capacity; Vehicle and Axle-Load Scales. - *For all vehicle and axle-load scales, the marked nominal capacity shall not exceed the concentrated load capacity (CLC) times the quantity of the number of sections in the scale minus 0.5.*

As a formula, this is stated as

$$\text{nominal capacity} \leq CLC \times (N - 0.5)$$

where N = the number of sections in the scale.

(See N.1.3.4. and T.N.3.1.)
[Nonretroactive as of January 1, 1989.]

[**Note:** When the device is used in a combination railway track and vehicle weighing application, the above formula shall apply only to the vehicle scale application.]
(Added 1988) (Amended 1999 and 2002)

S.6.2. Location of Marking Information. - Scales that are not permanently attached to an indicating element, and for which the load-receiving element is the only part of the weighing/load-receiving element visible after installation, may have the marking information required in G-S.1. of the General Code and S.6. of the Scales Code located in an area that is accessible only through the use of a tool; provided that the information is easily accessible (e.g., the information may appear on the junction box under an access plate). The identification information for these scales shall be located on the weighbridge (load-receiving element) near the point where the signal leaves the weighing element or beneath the nearest access cover.
(Added 1989)

S.6.3. Scales, Main Elements, and Components of Scales or Weighing Systems. - Scales, main elements of scales when not contained in a single enclosure for the entire scale, load cells for which Certificates of Conformance (CC) have been issued under the National Type Evaluation Program, and other equipment necessary to a weighing system, but having no metrological effect on the weighing system, shall be marked as specified in Table S.6.3.a. and explained in the accompanying notes (Table S.6.3.b.).
(Added 1990)

S.6.4. Railway Track Scales. - A railway track scale shall be marked with the maximum capacity of each section of the load-receiving element of the scale. Such marking shall be accurately and conspicuously presented on, or adjacent to, the identification or nomenclature plate that is attached to the indicating element of the scale. *The nominal capacity of a scale with more than two sections shall not exceed twice its rated section capacity. The nominal capacity of a two-section scale shall not exceed its rated section capacity.*
[Nonretroactive as of January 1, 2002]
(Amended 1988 and 2001)

S.6.5. Livestock Scales. - A livestock scale shall be marked with the maximum capacity of each section of the load-receiving element of the scale. Such marking shall be accurately and conspicuously presented on, or adjacent to the identification or nomenclature plate that is attached to the indicating element of the scale. *The nominal capacity of a scale with more than two sections shall not exceed twice its rated section capacity. The nominal capacity of a two-section scale shall not exceed its rated section capacity*.*
*[*Nonretroactive as of January 1, 2003]*
(Added 2002)

N. Notes

N.1. Test Procedures.

N.1.1. Increasing-Load Test. - The increasing-load test shall be conducted on all scales with the test loads approximately centered on the load-receiving element of the scale, except on a scale having a nominal capacity greater than the total available known test load. When the total test load is less than the nominal capacity, the test load is used to greatest advantage by concentrating it, within prescribed load limits, over the main load supports of the scale.

N.1.2. Decreasing-Load Test (Automatic Indicating Scales). - The decreasing-load test shall be conducted with the test load approximately centered on the load-receiving element of the scale.

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Table 3
Parameters for Accuracy Classes

Class	*Value of the verification scale division (d or e[1])*	*Number of scale[4] divisions (n)*	
		Minimum	*Maximum*
SI Units			
I	*equal to or greater than 1 mg*	*50 000*	------
II	*1 to 50 mg, inclusive*	*100*	*100 000*
	equal to or greater than 100 mg	*5000*	*100 000*
III[2]	*0.1 to 2 g, inclusive*	*100*	*10 000*
	equal to or greater than 5 g	*500*	*10 000*
III L[3]	*equal to or greater than 2 kg*	*2000*	*10 000*
IIII	*equal to or greater than 5 g*	*100*	*1 200*
INCH-POUND Units			
III	*0.0002 lb to 0.005 lb, inclusive*	*100*	*10 000*
	0.005 oz to 0.125 oz, inclusive	*100*	*10 000*
	equal to or greater than 0.01 lb	*500*	*10 000*
	equal to or greater than 0.25 oz	*500*	*10 000*
III L[3]	*equal to or greater than 5 lb*	*2 000*	*10 000*
IIII	*greater than 0.01 lb*	*100*	*1 200*
	greater than 0.25 oz	*100*	*1 200*

[1] For Class I and II devices equipped with auxiliary reading means (i.e., a rider, a vernier, or a least significant decimal differentiated by size, shape, or color), the value of the verification scale division "e" is the value of the scale division immediately preceding the auxiliary means.

[2] A scale marked "For prescription weighing only" may have a scale division not less than 0.01 g. (Added 1986)

[3] The value of a scale division for crane and hopper (other than grain hopper) scales shall be not less than 0.2 kg (0.5 lb). The minimum number of scale divisions shall be not less than 1000.

[4] On a multiple range or multi-interval scale the number of divisions for each range independently shall not exceed the maximum specified for the accuracy class. The number of scale divisions, n, for each weighing range is determined by dividing the scale capacity for each range by the verification scale division, e, for each range. On a scale system with multiple load receiving elements and multiple indications, each element considered shall not independently exceed the maximum specified for the accuracy class. If the system has a summing indicator, the n_{max} for the summed indication shall not exceed the maximum specified for the accuracy class.

[Nonretroactive as of January 1, 1986.]
(Amended 1986, 1987, 1997, 1998, 1999 and 2000) (Footnote 4 Added 1997) (Footnote 1 Amended 1999)

Table S.6.3.a.
Marking Requirements

To Be Marked With	Weighing Equipment				
	Weighing, load-receiving, and indicating element in same housing or covered on the same CC[1]	Indicating element not permanently attached to weighing and load-receiving element or covered by a separate CC	Weighing and load-receiving element not permanently attached to indicating element or covered by a separate CC	Load cell with CC (11)	Other equipment or device (10)
Manufacturer's ID (1)	x	x	x	x	x
Model Designation and Prefix (1)	x	x	x	x	x
Serial Number and Prefix (2)	x	x	x	x	x (16)
Certificate of Conformance Number (CC) (23)	x	x	x	x	x (23)
Accuracy Class (17)	x	x (8)	x (19)	x	
Nominal Capacity (3)(18)(20)	x	x	x		
Value of Scale Division, "d" (3)	x	x			
Value of "e" (4)	x	x			
Temperature Limits (5)	x	x	x	x	
Concentrated Load Capacity (CLC) (12)(20)(22)		x	x (9)		
Special Application (13)	x	x	x		
Maximum Number of Scale Divisions (n_{max}) (6)		x (8)	x (19)	x	
Minimum Verification Scale Division (e_{min})			x (19)		
"S" or "M" (7)				x	
Direction of Loading (15)				x	
Minimum Dead Load				x	
Maximum Capacity				x	
Safe Load Limit				x	
Load Cell Verification Interval (v_{min}) (21)				x	
Section Capacity (14)(20)(22)		x	x		

Note: For applicable notes, see Table S.6.3.b.

(Added 1990) (Amended 1992, 1999, 2000, 2001 and 2002) (Added Footnote 1, 2001)

[1] Weighing/load receiving elements and indicators which are in the same housing or which are permanently attached will generally appear on the same CC. If not in the same housing, elements shall be hard wired together or sealed with a physical seal or an electronic link. This requirement does not apply to peripheral equipment that has no input or effect on device calibrations or configurations.

Table S.6.3.b.

Notes For Table S.6.3.a.

1. Manufacturer's identification and model designation and *model designation prefix*.*
   **[Nonretroactive as of January 1, 2003.]*
   (See G-S.1.) *[Prefix lettering may be initial capitals, all capitals or all lower case.]*
   (Amended 2000)

2. *Serial number [Nonretroactive as of January 1, 1968] and prefix [Nonretroactive as of January 1, 1986].*
   (See G-S.1.)

3. The nominal capacity *and value of the scale division shall be shown together (e.g., 50 000 x 5 kg, 100 000 x 10 lb, 15 x 0.005 kg, or 30 x 0.01 lb) adjacent to the weight display when the nominal capacity and value of the scale division are not immediately apparent. Each scale division value or weight unit shall be marked on multiple range or multi-interval scales.*
   [Nonretroactive as of January 1, 1983.]

4. *Required only if different from "d."*
   [Nonretroactive as of January 1, 1986.]

5. *Required only on Class III, III L, and IIII devices if the temperature range on the NTEP CC is narrower then and within –10 °C to 40 °C (14 °F to 104 °F).*
   [Nonretroactive as of January 1, 1986.]

6. *This value may be stated on load cells in units of 1 000; e.g., n: 10 is 10 000 divisions.*
   [Nonretroactive as of January 1, 1988.]

7. *Denotes compliance for single or multiple load cell applications. It is acceptable to use a load cell with the "S" or Single Cell designation in multiple load cell applications as long as all other parameters meet applicable requirements. A load cell with the "M" or Multiple Cell designation can be used only in multiple load cell applications.*
   [Nonretroactive as of January 1, 1988.]
   (Amended 1999)

8. *An indicating element not permanently attached to a weighing element shall be clearly and permanently marked with the accuracy Class of I, II, III, III L, or IIII, as appropriate, and the maximum number of scale divisions, n_{max},, for which the indicator complies with the applicable requirement. Indicating elements that qualify for use in both Class III and III L applications may be marked III/III L and shall be marked with the maximum number of scale divisions for which the device complies with the applicable requirements for each accuracy class.*
   [Nonretroactive as of January 1, 1988.]

9. *For vehicle and axle-load scales only. The CLC shall be added to the load-receiving element of any such scale not previously marked at the time of modification.*
   [Nonretroactive as of January 1, 1989.]
   (Amended 2002)

10. Necessary to the weighing system but having no metrological effect, e.g., auxiliary remote display, keyboard, etc.

11. *The markings may be either on the load cell or in an accompanying document; except that, if an accompanying document is provided, the serial number shall appear both on the load cell and in the document. [Nonretroactive as of January 1, 1988.] The manufacturer's name or trademark, the model designation, and identifying symbol for the serial number shall also be marked both on the load cell and in any accompanying document.*
    [Nonretroactive as of January 1, 1991.]

12. Required on the indicating element *and the load-receiving element* of vehicle and axle-load scales. *Such marking shall be identified as "concentrated load capacity" or by the abbreviation "CLC".**
    *[*Nonretroactive as of January 1, 1989.]*
    (Amended 2002)

13. *A scale designed for a special application rather than general use shall be conspicuously marked with suitable words visible to the operator and customer restricting its use to that application, e.g., postal scale, prepack scale, weight classifier, etc.* When a scale is installed with an operational counting feature, the scale shall be marked on both the operator and customer side with the statement "The counting feature is not legal for trade."*
    *[*Nonretroactive as of January 1, 1986.]*
    (Amended 1994)

14. *Required on livestock* and railway track scales. When marked on vehicle and axle-load scales manufactured before January 1, 1989, it may be used as the CLC. For livestock scales manufactured between January 1, 1989 and January 1, 2003, required markings may be either CLC or section capacity.*
    *[*Nonretroactive as of January 1, 2003.]*
    (Amended 2002)

Table S.6.3.b.

Notes For Table S.6.3.a. (Continued)

15. *Required if the direction of loading the load cell is not obvious.*
[Nonretroactive as of January 1, 1988.]

16. *Serial number [Nonretroactive as of January 1, 1968] and prefix [Nonretroactive as of January 1, 1986].* (See G-S.1.) Modules without "intelligence" on a modular system (e.g., printer, keyboard module, cash drawer, and secondary display in a point-of-sale system) are not required to have serial numbers.

17. *The accuracy Class of a device shall be marked on the device with the appropriate designation as I, II, III, III L, or IIII.*
[Nonretroactive as of January 1, 1986.]

18. The nominal capacity shall be conspicuously marked as follows:
    (a) on any scale equipped with unit weights or weight ranges;
    (b) on any scale with which counterpoise or equal-arm weights are intended to be used;
    (c) on any automatic-indicating or recording scale so constructed that the capacity of the indicating or recording element, or elements, is not immediately apparent;
    (d) on any scale with a nominal capacity less than the sum of the reading elements; and
    *(e) on the load-receiving element (weighbridge) of vehicle, axle-load, and livestock scales.**
    *[*Nonretroactive as of January 1, 1989.]*

19. *Nonretroactive as of January 1, 1988.*
(Amended 1992)

20. *Combination vehicle/railway track scales must be marked with both the nominal capacity and CLC for vehicle weighing and the nominal capacity and section capacity for railway weighing. All other requirements relating to these markings will apply.*
[Nonretroactive as of January 1, 2000]
(Added 1999)

21. The value of the load cell verification interval (v_{min}) must be stated in mass units. In addition to this information, a device may be marked with supplemental representations of v_{min}.
[*Nonretroactive as of January 1, 2001*]
(Added 1999)

22. *Combination vehicle/livestock scales must be marked with both the CLC for vehicle weighing and the section capacity for livestock weighing. All other requirements relative to these markings will apply.*
[Nonretroactive as of January 1, 2003]
(Added 2002)

23. Required only if a CC has been issued for the device or equipment.
[Nonretroactive as of January 1, 2003]
(G-S.1. Identification (f) Added 2001)

N.1.2.1. Scales Marked I, II, III, or IIII. - Except for portable wheel load weighers, decreasing-load tests shall be conducted on scales marked I, II, III, or IIII and with n equal to or greater than 1000 with test loads equal to the maximum test load at each tolerance value. For example, on a Class III scale, at test loads equal to 4000d, 2000d, and 500d; for scales with n less than 1000, the test load shall be equal to one-half of the maximum load applied in the increasing-load test. (See Table 6.)
(Amended 1998)

N.1.2.2. All Other Scales. - On all other scales, except for portable wheel load weighers, the decreasing-load test shall be conducted with a test load equal to one-half of the maximum load applied in the increasing-load test.
(Amended 1998)

N.1.3. Shift Test.

N.1.3.1. Bench or Counter Scales. - A shift test shall be conducted with a half-capacity test load centered successively at four points equidistant between the center and the front, left, back, and right edges of the load-receiving element.

N.1.3.2. Dairy-Product-Test Scales. - A shift test shall be conducted with a test load of 18 grams successively positioned at all points on which a weight might reasonably be placed in the course of normal use of the scale.

N.1.3.3. Equal-Arm Scales. - A shift test shall be conducted with a half-capacity test load positioned on each pan as prescribed in N.1.3.1. An equal test load shall be centered on the other pan.

Sec. 2.21. Belt-Conveyor Scale Systems

A. Application

A.1. This code applies to belt-conveyor scale systems used for the weighing of bulk materials.

A.2. The code does not apply to:

(a) devices used for discrete weighing while moving on conveyors;

(b) devices that measure quantity on a time basis;

(c) check-weighers; or

(d) controllers or other auxiliary devices except as they may affect the weighing performance of the belt-conveyor scale.

A.3. See also General Code requirements.

S. Specifications

S.1. Design of Indicating and Recording Elements.

S.1.1. General. - A belt-conveyor scale shall be equipped with a primary indicating element in the form of a master weight totalizer *and shall also be equipped with a recording element, and a rate of flow indicator and recorder (which may be analog).** An auxiliary indicator shall not be considered part of the master weight totalizer.
*[*Nonretroactive as of January 1, 1986.]*
(Amended 1986)

S.1.2. Units. - A belt-conveyor scale shall indicate and record weight units in terms of pounds, tons, long tons, metric tons, or kilograms. The value of a scale division (d) expressed in a unit of weight shall be equal to:

(a) 1, 2, or 5, or

(b) a decimal multiple or submultiple of 1, 2, or 5.

S.1.3. Value of the Scale Division.

S.1.3.1. For Scales Installed After January 1, 1986. *The value of the scale division shall not be greater than 0.1 percent (1/1 000) of the minimum totalized load.*
[Nonretroactive as of January 1, 1986.]

S.1.3.2. For Scales Installed Before January 1, 1986. - The value of the scale division shall not be greater than 1/1200 of the rated capacity of the device. However, provision shall be made so that compliance with the requirements of the zero-load test as prescribed in N.3.1. may be readily and accurately determined in 20 minutes of operation.

S.1.4. Recording Elements and Recorded Representations. - *The value of the scale division of the recording element shall be the same as that of the indicating element. The belt-conveyor scale system shall record the initial indication and the final indication of the master weight totalizer*, the quantity delivered*, the unit of measurement (i.e., kilograms, tonnes, pounds, tons, etc.), the date, and time. This information shall be recorded for each delivery*.*
[Nonretroactive as of January 1, 1986.]
*[*Nonretroactive as of January 1, 1994.]*
(Amended 1993)

S.1.4.1. *The belt-conveyor scale system shall be capable of recording the results of automatic or semi-automatic zero load tests.***
*[**Nonretroactive as of January 1, 2004.]*
(Added 2002)

S.1.5. Rate of Flow Indicators and Recorders. - *A belt-conveyor scale shall be equipped with a rate of flow indicator and an analog or digital recorder. Permanent means shall be provided to produce an audio or visual signal when the rate of flow is equal to or less than 35 percent and when the rate of flow is equal to or greater than 98 percent of the rated capacity of the scale. The type of alarm (audio or visual) shall be determined by the individual installation.*
[Nonretroactive as of January 1, 1986.]
(Amended 1989)

S.1.6. Advancement of Primary Indicating or Recording Elements. - The master weight totalizer shall advance only when the belt conveyor is in operation and under load.
(Amended 1989)

S.1.7. Master Weight Totalizer. - *The master weight totalizer shall not be resettable without breaking a security means.*
[Nonretroactive as of January 1, 1986.]

S.1.8. Power Loss. - *In the event of a power failure of up to 24 hours, the accumulated measured quantity on the master weight totalizer of an electronic digital indicator shall be retained in memory during the power loss.*
[Nonretroactive as of January 1, 1986.]
(Amended 1989)

S.2. Design of Weighing Elements. - A belt-conveyor scale system shall be designed to combine automatically belt travel with belt load to provide a determination of the weight of the material that has passed over the scale.

S.2.1. Speed Measurement. - A belt-conveyor scale shall be equipped with a belt speed or travel sensor that will accurately sense the belt speed or travel whether the belt is empty or loaded.

S.2.2. Adjustable Components. - An adjustable component that can affect the performance of the device (except as prescribed in S.3.1) shall be held securely in adjustment and shall not be capable of adjustment without breaking a security means.

S.2.3. Overload Protection. - The load-receiving elements shall be equipped with means for overload protection of not less than 150 percent of rated capacity. The accuracy of the scale in its normal loading range, shall not be affected by overloading.

S.3. Zero Setting.

S.3.1. Design of Zero-Setting Mechanism. - Automatic and semiautomatic zero-setting mechanisms shall be so constructed that the resetting operation is carried out only after a whole number of belt revolutions and the completion of the setting or the whole operation is indicated. *An audio or visual signal shall be given when the automatic and semiautomatic zero-setting mechanisms reach the limit of adjustment of the zero-setting mechanism.**

Except for systems that do not record the zero load reference at the beginning and end of a delivery, the range of the zero-setting mechanism shall not be greater than ±2 percent of the rated capacity of the scale without breaking the security means. *For systems that record the zero load reference at the beginning and end of a delivery, the range of zero-setting mechanism shall not be greater than ±5 percent without breaking the security means.***

*[*Nonretroactive as of January 1, 1990]*
*[**Nonretroactive as of January 1, 2004]*
(Amended 1989 and 2002)

S.3.2. Sensitivity at Zero Load (For Type Evaluation). - *When a system is operated for a time period equal to the time required to deliver the minimum test load and with a test load calculated to indicate two scale divisions applied directly to the weighing element, the totalizer shall advance not less than one or more than three scale divisions. An alternative test of equivalent sensitivity, as specified by the manufacturer, shall also be acceptable. [Nonretroactive as of January 1, 1986.]*

S.4. Marking Requirements. - A belt-conveyor scale shall be marked with the following: (Also see G-S.1.)

(a) the rated capacity in units of weight per hour (minimum and maximum);

(b) the value of the scale division;

(c) the belt speed in terms of feet (or meters) per minute at which the belt will deliver the rated capacity;

(d) the load in terms of pounds per foot or kilograms per meter (determined by materials tests);

(e) the operational temperature range if other than -10 to 40 °C (14 to 104 °F). [Nonretroactive as of January 1, 1986.]

S.5. Provision for Sealing. - *A device shall be designed using the format set forth in Table S.5. with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g. data change audit trail available at the time of inspection), before any change that affects the metrological integrity of the device can be made to any electronic mechanism. [Nonretroactive as of January 1, 1999]*
Added 1998)

Table S.5. Categories of Device and Methods of Sealing

Categories of Devices	*Method of Sealing*
Category 1: No remote configuration capability.	*Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.*
Category 3: Remote configuration capability.	*An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to ten times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)*

(Nonretroactive as January 1, 1998) (Table Added 1998)

N. Notes

N.1. General. - Belt-conveyor scales are capable of weighing bulk material accurately. (See Tolerances.) However, their performance can be detrimentally affected by the conditions of the installation. (See User Requirements.) The performance of the equipment is not to be determined by averaging the results of the individual tests. The results of all tests shall be within the tolerance limits.
(Amended 2002)

N.1.1. Official Test. - An official test of a belt-conveyor scale system shall be a materials test.

N.1.2. Simulated Test. - Simulated loading conditions as recommended by the manufacturer and approved by the official with statutory authority may be used to properly monitor the systems operational performance between official tests, but shall not be used for official certification.
(Amended 1991)

N.2. Conditions of Tests. - A belt-conveyor scale shall be tested after it is installed on the conveyor system with which it is to be used and under such environmental conditions as may normally be expected. It shall be tested at normal use capacity and may also be tested at any other rate of flow that may be used at the installation. Each test shall be conducted for:

(a) not less than 1 000 scale divisions,

(b) at least three revolutions of the belt, and

(c) at least 10 minutes of operation, or for a normal weighment.

(Amended 1986)

N.3. Test Procedures.

N.3.1. Zero Load Tests. - A zero-load test shall be conducted to establish that the belt scale system (including the conveyor) is capable of holding a stable, in-service zero.
(Amended 1989 and 2002)

N.3.1.1. Determination of Zero. - A "Zero-Load Test" is a determination of the error in zero, expressed as an internal reference, a percentage of the full-scale capacity, or a change in a totalized load over a whole number of complete belt revolutions. For belt-conveyor scales with electronic integrators, the test must be performed over a period of at least 3 minutes and with a whole number of complete belt revolutions. For belt-conveyor scales with mechanical integrators, the test shall be performed with no less than three complete revolutions or 10 minutes operation, whichever is greater.
(Added 2002)

N.3.1.2. Initial Stable Zero. - The conveyor system shall be run to warm up the belt and the belt scale shall be zero adjusted as required. A series of zero-load tests shall be carried out until three consecutive zero-load tests each indicate an error which does not exceed ±0.06 % of the full-scale capacity or ±1 division, whichever is less. No adjustments can be made during the three consecutive zero-load test readings.
(Added 2002)

N.3.1.3. Test of Zero Stability. - The conveyor system shall be run to warm up the belt and the belt scale shall be zero adjusted as required. A series of zero-load tests shall be carried out immediately before the simulated or materials test until the three consecutive zero-load tests each indicate an error which does not exceed ±0.06 % of the full-scale capacity or ±1 division, whichever is less. No adjustments can be made during the three consecutive zero-load test readings.

Immediately after material has been weighed over the belt-conveyor scale during the conduct of the materials test, the zero-load test shall be repeated. The zero error from this test shall not exceed ±0.12 % of the full-scale capacity or ±2 divisions, whichever is less.
(Added 2002)

N.3.1.4. Check For Consistency of the Conveyor Belt Along Its Entire Length. - After a zero-load test with flow rate filtering disabled, the totalizer shall not change more than three scale divisions from its initial indication during one complete belt revolution.
(Added 2002)

N.3.2. Material Tests. – Material tests should be conducted using actual belt loading conditions. These belt loading conditions shall include, but are not limited to conducting materials tests using different belt loading points, all types and sizes of products weighed on the scale, at least one other belt speed, and in both directions of weighing.

On initial verification, at least three individual tests shall be conducted. On subsequent verifications, at least two individual tests shall be conducted. The results of all these tests shall be within the tolerance limits.

Either pass a quantity of pre-weighed material over the belt-conveyor scale in a manner as similar as feasible to actual loading conditions, or weigh all material that has passed over the belt-conveyor scale. Means for weighing the material test load will depend on the capacity of the belt-conveyor scale and availability of a suitable scale for the test. To assure that the test load is accurately weighed and determined, the following precautions shall be observed:
(Amended 2002)

(a) The containers, whether railroad cars, trucks, or boxes, must not leak, and shall not be overloaded to the point that material will be lost.

(b) The actual empty or tare weight of the containers shall be determined at the time of the test. Stenciled tare weight of railway cars or trucks shall not be used. Gross and tare weights shall be determined on the same scale.

(c) When a pre-weighed test load is passed over the scale, the belt loading hopper shall be examined before and after the test to assure that the hopper is empty and that only the material of the test load has passed over the scale.

(d) Where practicable, a reference scale should be tested within 24 hours preceding the determination of the weight of the test load used for a belt-conveyor scale material test.

A reference scale which is not "as found" within maintenance tolerance should have its accuracy re-verified after the belt-conveyor test with a suitable known weight load if the "as found" error of the belt-conveyor scale material test exceeds maintenance tolerance values.

(e) If any suitable known weight load other than a certified test weight load is used for re-verification of the reference scale accuracy, its weight shall be determined on the reference scale after the reference scale certification and before commencing the belt scale material test.

Note: Even if the reference scale is within maintenance tolerance it may require adjusting to be able to meet paragraph N.3.2.1.

(f) The test shall not be conducted if the weight of the test load has been affected by environmental conditions.

(Amended 1986, 1989, 1998, 2000 and 2002)

N.3.2.1. Accuracy of Material. - The quantity of material used to conduct a material test shall be weighed on a reference scale to an accuracy within 0.1 percent. Scales typically used for this purpose include Class III and III L scales or a scale without a class designation as described in Handbook 44, Section 2.20, Table T.1.1.
(Added 1989) (Amended 1991, 1993, 1998 and 2000)

N.3.3. Simulated Load Tests.

(a) As required by the official with statutory authority, simulated load tests as recommended by the manufacturer are to be conducted between material tests to monitor the system's operational performance, but shall not be used for official certification.
(Amended 1991)

(b) A simulated load test consisting of at least three consecutive test runs shall be conducted as soon as possible, but not more than 12 hours after the completion of the material test, to establish the factor to relate the results of the simulated load test to the results of the material tests.
(Added 1990)

(c) The results of the simulated load test shall repeat within 0.1 percent.
(Added 1990)

(Amended 1989 and 1990)

T. Tolerances

T.1. Tolerance Values[1]. - Maintenance and acceptance tolerances on materials tests, relative to the weight of the material, shall be ± 0.25 percent of the test load.
(Amended 1993)

T.2. Tolerance Values, Repeatability Tests. - The variation in the values obtained during the conduct of materials tests shall not be greater than 0.25 percent (1/400).

T.3. Influence Factors. - The following factors are applicable to tests conducted under controlled conditions only, provided that:

(a) types of devices approved prior to January 1, 1986, and manufactured prior to January 1, 1988, need not meet the requirements of this Section; and

(b) new types of devices submitted for approval after January 1, 1986, shall comply with the requirements of the Section; and

(c) all devices manufactured after January 1, 1988, shall comply with the requirements of this Section.

[1] The variables and uncertainties included in the relative tolerance represent only part of the variables that affect the accuracy of the material weighed on belt-conveyor scales. If this tolerance was based on an error analysis beginning with mass standards through all of the test processes and following the principle expressed in Section 3.2. of the Fundamental Considerations in Appendix A of Handbook 44, the tolerance would be 0.5 percent.
(Added 1993)

T.3.1. Temperature. - Devices shall satisfy the tolerance requirements at temperatures from -10 to 40 °C (14 to 104 °F).

T.3.1.1. Effect on Zero-Load Balance. - The zero-load indication shall not change by more than 0.07 percent of the rated capacity of the scale (without the belt) for a change in temperature of 10 °C (18 °F) at a rate not to exceed 5 °C (9 °F) per hour.

T.3.1.2. Temperature Limits. - *If a temperature range other than -10 to 40 °C (14 to 104 °F) is specified for the device, the range shall be at least 30 °C (54 °F).*
[Nonretroactive as of January 1, 1990.]
(Added 1989)

T.3.2. Power Supply, Voltage and Frequency. - A belt-conveyor scale system shall satisfy the tolerance requirements over a range of 100 to 130 V or 200 to 250 V as appropriate and over a frequency range of 59.5 to 60.5 Hz.

UR. User Requirements

UR.1. Use Requirements. - A belt-conveyor scale system shall be operated between 35 and 98 percent of its rated capacity.

UR.1.1. Minimum Totalized Load. - Delivered quantities of less than the minimum test load shall not be considered a valid weighment.

UR.1.2. Security Means. - When a security means has been broken, it shall be reported to the official with statutory authority.
(Amended 1991)

UR.2. Installation Requirements.

UR.2.1. Protection from Environmental Factors. - The indicating elements, the lever system or load cells, and the load-receiving element of a belt-conveyor scale shall be adequately protected from environmental factors such as wind, moisture, dust, weather, and radio frequency interference (RFI) and electromagnetic interference (EMI) that may adversely affect the operation or performance of the device.

UR.2.2. Conveyor Installation. - The design and installation of the conveyor leading to and from the belt-conveyor scale is critical with respect to scale performance. The conveyor may be horizontal or inclined, but if included, the angle shall be such that slippage of material along the belt does not occur. Installation shall be in accordance with the scale manufacturer's instructions and the following:
(Amended 2002)

(a) **Installation - General.** - A belt-conveyor scale shall be so installed that neither its performance nor operation will be adversely affected by any characteristic of the installation, including but not limited to, the foundation, supports, covers, or any other equipment.
(Amended 2002)

(b) **Live Portions of Scale.** - All live portions of the scale shall be protected by appropriate guard devices to prevent accidental interference with the weighing operation.

(c) **Storage of Simulated Load Equipment.** - Suitable protection shall be provided for storage of any simulated load equipment.

(d) **Take-up Device.** - If the belt length is such that a take-up device is required, this device shall be of the counter-weighted type for either vertical or horizontal travel.

(e) **Scale Location and Training Idlers.** - The scale shall be so installed that the first weigh idler of the scale is at least 6 m (20 ft) or 5 idler spaces, whichever is greater, from loading point, skirting, head or tail pulley, or convex curve in the conveyor. Any training idler shall be located at least 18 m (60 ft) from the center line of the weigh span of the scale. Training idlers shall not be restrained at any time in order to force belt alignment.
(Amended 1998)

(f) **Concave Curve.** - If there is a concave curve in the conveyor, before or after the scale, the scale shall be installed so that the belt is in contact with all the idler rollers at all times for at least 6 m (20 ft) or 5 idler spaces, whichever is greater, before and after the scale.[2] A concave curve shall start no closer than 12 m (40 ft) from the scale to the tangent point of the concave curve.
(Amended 1998)

[2] Installing the belt scale 5 idler spaces from the tail pulley or the infeed skirting will be in the area of least belt tension on the conveyor and should produce the best accuracy. The performance of a belt-conveyor scale may be adversely affected by a concave curve in the conveyor that is located between the loading point and the scale. Therefore, whenever possible, a belt-conveyor scale should not be installed with a concave curve in the conveyor between the loading point and the scale.
(Amended 1995 and 1998)

(g) **Tripper and Movable Pulleys. -** There shall be no tripper or movable head pulleys in the conveyor.

(h) ***Conveyor Length.*** *- The conveyor shall be no longer than 300 m (1000 ft) nor shorter than 12 m (40 ft) from head to tail pulley.*
[Nonretroactive as of January 1, 1986.]

(i) **Conveyor Orientation** - The conveyor may be horizontal or inclined, but, if inclined, the angle shall be such that slippage of material along the belt does not occur.

(j) **Conveyor Stringers.** - Conveyor stringers at the scale and for not less than 6 m (20 ft) before and beyond the scale shall be continuous or securely joined and of sufficient size and so supported as to eliminate relative deflection between the scale and adjacent idlers when under load. The conveyor stringers should be so designed that the deflection between any two adjacent idlers within the weigh area does not exceed 0.6 mm (0.025 in) under load.

(k) **Identification of Scale Area.** - The scale area and 5 idlers on both ends of the scale shall be of a contrasting color, or other suitable means shall be used to distinguish the scale from the remainder of the conveyor installation, and the scale shall be readily accessible.
(Amended 1998)

(l) **Belt Composition and Maintenance.** - Conveyor belting shall be no heavier than is required for normal use. In a loaded or unloaded condition, the belt shall make constant contact with horizontal and wing rollers of the idlers in the scale area. Splices shall not cause any undue disturbance in scale operation (see N.3.).
(Amended 1998, 2000 and 2001)

(m) **Uniformity of Belt Loading and Flow.** - The conveyor loading mechanism shall be designed to provide uniform belt loading. The distance from the loading point to the scale shall allow for adequate settling time of the material on the belt before it is weighed. Feeding mechanisms shall have a positive closing or stopping action so that material leakage does not occur. Feeders shall provide an even flow over the scale through the full range of scale operation. Sufficient impact idlers shall be provided in the conveyor under each loading point to prevent deflection of the belt during the time material is being loaded.

(n) **Belt Alignment.** - The belt shall not extend beyond the edge of the idler roller in any area of the conveyor.
(Amended 1998)
(Amended 2000)

UR.2.3. Material Test. *- A belt-conveyor scale shall be installed so that a material test can be conveniently conducted.*
[Nonretroactive as of January 1, 1981.]

UR.2.4. Belt Travel (Speed or Velocity). - The belt travel sensor shall be so positioned that it accurately represents the travel of the belt over the scale for all flow rates between the maximum and minimum values. The belt travel sensor shall be so designed and installed that there is no slip.

UR.3. Use Requirements.

UR.3.1. Loading. - The feed of material to the scale shall be controlled to assure that, during normal operation, the material flow is in accordance with manufacturer's recommendation for rated capacity.

UR.3.2. Maintenance. - Belt-conveyor scales and idlers shall be maintained and serviced in accordance with manufacturer's instructions and the following:

(a) The scale and area surrounding the scale shall be kept clean of debris or other foreign material that can detrimentally affect the performance of the system.

(b) Simulated load tests or material tests, and zero load tests shall be conducted at periodic intervals between official tests in order to provide reasonable assurance that the device is performing correctly.

The action to be taken as a result of the material tests or simulated load tests is as follows:
(Amended 2000 and 2002)

- if the error is less than 0.25 percent, no adjustment is to be made;

- if the error is at least 0.25 percent but not more than 0.6 percent, adjustment may be made if the official with statutory authority is notified;
(Amended 1991)

- if the error is greater than 0.6 percent but does not exceed 0.75 percent, adjustments shall be made only by a competent service person and the official with statutory authority shall be notified. After such an adjustment, if the results of a subsequent test require adjustment in the same direction, an official test shall be conducted;
(Amended 1991)

- if the error is greater than 0.75 percent, an official test is required.
(Amended 1987)

(c) Scale Alignment. - Alignment checks shall be conducted in accordance with the manufacturer's recommendation when conveyor work is performed in the scale area. A material test is required after any realignment.
(Amended 1986 and 2000)

(d) Simulated Load Equipment. - Simulated load equipment shall be clean and properly maintained.

(e) Zero Load Reference Information. – When zero load reference information is recorded for a delivery, the information must be based upon zero load tests performed as a minimum both immediately before and immediately after the totalized load.
(Added 2002)

UR.3.3. Retention of Maintenance, Test, and Analog or Digital Recorder Information. - Records of calibration and maintenance, including conveyor alignment, analog or digital recorder, zero-load test, and material test data shall be maintained on site for at least the three concurrent years as a history of scale performance. Copies of any report as a result of a test or repair shall be mailed to the official with statutory authority as required. The current date and correction factor(s) for simulated load equipment shall be recorded and maintained in the scale cabinet.
(Added 2002)

UR.4. Compliance. - Prior to initial verification, the scale manufacturer or installer shall certify to the owner that the scale meets code requirements. Prior to initial verification and each subsequent verification, the scale owner or his agent shall notify the official with statutory authority in writing that the belt-conveyor scale system is in compliance with this specification and ready for material testing.
(Amended 1991)

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Table N.3.2. Test Loads
At or near minimum capacity
At or near maximum capacity
At two (2) critical points between minimum and maximum capacity
Test may be conducted at other loads if the device is intended for use at other specific capacities

N.2.2. Influence Factor Testing. Influence factor testing shall be conducted statically.

N.3. Test Procedures - Weigh Labelers. If the device is designed for use in static weighing, it shall be tested statically using mass standards.

Note: If the device is designed for only dynamic weighing it shall only be tested dynamically.

N.3.1. Laboratory - Static Tests.

N.3.1.1. Increasing-Load Test. The increasing-load test shall be conducted with the test loads approximately centered on the load-receiving element of the scale.

N.3.1.2. Decreasing-Load Test. The decreasing-load test shall be conducted with the test loads approximately centered on the load-receiving element of the scale.

N.3.1.3. Shift Test. To determine the effect of off-center loading, a test load equal to one-half (1/2) maximum capacity shall be placed in the center of each of the four points equidistant between the center and front, left, back and right edges of the load receiver.

N.3.1.4. Discrimination Test. A discrimination test shall be conducted with the weighing device in equilibrium at zero load and at maximum test load, and under controlled conditions in which environmental factors are reduced to the extent that they will not affect the results obtained. This test is conducted from just below the lower edge of the zone of uncertainty for increasing load tests, or from just above the upper edge of the zone of uncertainty for decreasing-load tests.

N.3.1.5. Zero-Load Balance Change. A zero-load balance change test shall be conducted on all automatic weighing systems after the removal of any test load. The zero-load balance should not change by more than the minimum tolerance applicable. (Also see G-UR.4.2.)

N.3.1.6. Influence Factor Testing. Influence factor testing shall be conducted.

N.3.2. Laboratory - Dynamic Tests. The device shall be tested at the highest speed for each weight range using standardized test pucks or packages. Test runs shall be conducted using four test loads as described in Table N.3.2. Each test load shall be run a minimum of 10 consecutive times.

N.3.2.1. Shift Tests. To determine the effect of eccentric loading, for devices without a means to align packages, a test load equal to one-third (1/3) maximum capacity shall be passed over the load receiver or transport belt (1) halfway between the center and front edge, and (2) halfway between the center and back edge.

N.3.3. Field Test Procedures.

N.3.3.1. Static Tests. If the automatic weighing system is designed to operate statically, and used in that manner, during normal use operation, it shall be tested statically using mass standards. The device shall not be tested statically if it is used only dynamically.

N.3.3.2. Dynamic Tests. The device shall be tested at the normal operating speed using packages. Test runs should be conducted using at least two test loads distributed over its normal weighing range (e.g., at the lowest and highest ranges in which the device is typically operated). Each test load should be run a minimum of 10 consecutive times.

N.4. Test Procedures - Automatic Checkweigher.

N.4.1. Laboratory - Static Tests. If the scale is designed to operate statically during normal user operation, it shall be tested statically using the applicable weigh labeler requirements.

N.4.2. Laboratory - Dynamic Tests. The device shall be tested at the highest speed in each weight range using standardized test pucks or packages. Test runs shall be conducted using four test loads. The number of consecutive test weighments shall be as described in Table N.4.2.

Table S.7.a. Marking Requirements						
Weighing Equipment To Be Marked With		Weighing, load-receiving, and indicating element in same housing	Indicating element not permanently attached to weighing and load-receiving element	Weighing and load-receiving element not permanently attached to indicating element	Load cell with CC (11)	Other equipment or device (10)
Manufacturer's ID	(1)	X	X	X	X	
Model Designation	(1)	X	X	X	X	
Serial Number and Prefix	(2)	X	X	X	X	
Certificate of Conformance Number	(16)	X	X	X	X	X(16)
Accuracy Class	(14)	X	X(8)	X	X	X
Nominal Capacity	(3)(15)	X	X	X		X
Value of Division, d	(3)	X	X			X(13)
Value of "e"	(4)	X	X			
Temperature Limits	(5)	X	X	X	X	
Special Application	(11)	X	X	X		
Maximum Number of Scale Divisions n_{max}	(6)		X(8)	X	X	
Minimum Verification Division (e_{min})				X		
"S" or "M"	(7)				X	
Direction of Loading	(12)				X	
Minimum Dead Load					X	
Maximum Capacity (Max)		X			X	
Minimum Capacity (Min)		X				
Safe Load Limit					X	
Load Cell Verification Interval (v_{min})					X	
Maximum Belt Speed (m/sec or m/min)		X		X		

Note: See Table S.7.b. for applicable notes.
(Amended 1999 and 2002)

Table S.7.b.
Notes for Table S.7.a.

1. Manufacturer's identification and model designation. (See G-S.1.)
2. Serial number and prefix. (See G-S.1.)
3. The nominal capacity and value of the automatic weighing system division shall be shown together (e.g., 50 000 x 5 kg, or 30 x 0.01 lb) adjacent to the weight display when the nominal capacity and value of the automatic weighing system division are not immediately apparent. Each division value or weight unit shall be marked on variable-division value or division-unit automatic weighing systems.
4. Required only if different from "d."
5. Required only on automatic weighing systems if the range is other than -10 °C to 40 °C (14 °F to 104 °F).
6. This value may be stated on load cells in units of 1000 (e.g., n: 10 is 10 000 divisions).
7. Denotes compliance for single or multiple load cell applications.
8. An indicating element not permanently attached to a weighing element shall be clearly and permanently marked with the accuracy Class III, and the maximum number of divisions, n_{max}.
9. Necessary to the weighing system but having no metrological effect, e.g., auxiliary remote display, keyboard, etc.
10. The markings may be either on the load cell or in an accompanying document; except that, if an accompanying document is provided, the serial number shall appear both on the load cell and in the document. The manufacturer's name or trademark, the model designation, and identifying symbol for the serial number shall also be marked both on the load cell and in any accompanying document.
11. An automatic weighing system designed for a special application rather than general use shall be conspicuously marked with suitable words visible to the operator and customer restricting its use to that application.
12. Required if the direction of loading the load cell is not obvious.
13. Serial number and prefix (See G-S.1) modules without "intelligence" on a modular system (e.g., printer, keyboard module, cash drawer, and secondary display in a point-of-sale system) are not required to have serial numbers.
14. The accuracy Class of a device shall be marked on the device with the appropriate designation.
15. The nominal capacity shall be conspicuously marked on any automatic-indicating or recording automatic weighing system so constructed that the capacity of the indicating or recording element, or elements, is not immediately apparent.
16. Required only if a CC has been issued for the equipment.

(Amended 2002)

N.4.3. Field Test Procedures.

N.4.3.1. Static Tests. If the scale is designed to operate statically during normal user operation, it shall be tested statically according to sections N.3.1 through N.3.1.5.

N.4.3.2. Dynamic Tests. The device shall be tested dynamically at the highest normal operating speed using packages at two test loads distributed over its normal weighing range. The number of consecutive weighments shall be one-half (1/2) of those specified in Table N.4.2., but not less than 10.

Table N.4.2. Number of Sample Weights per Test for Automatic Checkweighers	
Weighing Range m = mass of test load	Number of samples weights per test
20 divisions ≤ m ≤ 10 kg 20 divisions ≤ m ≤ 22 lb	60
10 kg < m ≤ 25 kg 22 lb < m ≤ 55 lb	32
25 kg < m ≤ 100 kg 55 lb < m ≤ 220 lb	20
100 kg (220 lb) < m	10

T. Tolerances

T.1. Principles.

T.1.1. Design. The tolerance for a weighing device is a performance requirement independent of the design principle used.

T.1.2. Scale Division. The tolerance for a weighing device is related to the value of the scale division (d) or the value of the verification scale division (e) and is generally expressed in terms of d or e. The random tolerance for automatic checkweighers is expressed in terms of Maximum Allowable Variance (MAV).

T.2. Tolerance Application.

T.2.1. General. The tolerance values are positive (+) and negative (-) with the weighing device adjusted to zero at no load. When tare is in use, the tolerance values are applied from the tare zero reference; the tolerance values apply to certified test loads only.

T.2.2. Type Evaluation Examinations. For type evaluation examinations, the tolerance values apply to increasing and decreasing load tests within the temperature, power supply, and barometric pressure limits specified in T.7.

T.2.3. Multiple Range and Multi-Interval Automatic Weighing System. For multiple range and multi-interval devices, the tolerance values are based on the value of the scale division of the range in use.

T.3. Tolerance Values.

T.3.1. Tolerance Values - Class III Weigh-Labeler. (See T.3.2. for Class IIIS Weigh-Labelers.)

T.3.1.1. Static Tests. - Tolerance values shall be as specified in Table T.3., Class III - Tolerances in Divisions.

T.3.1.2. Dynamic Tests. – Acceptance tolerance values shall be the same as maintenance tolerance values specified in Table T.3., Class III - Tolerances in Divisions.

Table T.3. Class III – Tolerances in Divisions (d)				
Maintenance	1	2	3	5
Acceptance	0.5	1	1.5	2.5
Class	Test Load in Divisions			
III	0 - 500	501 - 2000	2001 - 4000	4001+

T.3.2. Tolerances Values - Class IIIS Weigh-Labelers in Package Shipping Applications.
(Added 1997)

T.3.2.1. Static Tests. - Tolerance values shall be as specified in Table T.3.2.1. Static Tolerances for Class IIIS Weigh-Labelers.

T.3.2.2. Dynamic Tests. - Tolerance values specified in Table T.3.2.2. Dynamic Tolerances for Class IIIS Weigh-Labelers shall be applied.

Table T.3.2.1. Static Tolerance for Class IIIS Weigh-Labelers		
Test Load in Divisions	Tolerance in Divisions	
Class IIIS	Acceptance	Maintenance
0 - 50	± 0.5	± 1
51 - 200	± 1	± 2
201 - 1000	± 1.5	± 3

(Added 1997)

Table T.3.2.2. Dynamic Tolerance for Class IIIS Weigh-Labelers		
Test Load in Divisions	Tolerance in Divisions	
Class IIIS	Acceptance	Maintenance
0 - 50	± 1.5	±2
51 - 200	± 2	±3
201 - 1000	± 2.5	±4

(Added 1997)

S.2.8. Exhaustion of Supply, Lubricant Devices Other Than Meter Types. - When the level of the supply of lubricant becomes so low as to compromise the accuracy of measurement, the device shall:

(a) become inoperable automatically, or

(b) give a conspicuous and distinct warning.

S.3. Discharge Lines and Valves.

S.3.1. Diversion of Measured Liquid. - No means shall be provided by which any measured liquid can be diverted from the measuring chamber of the meter or its discharge line. Two or more delivery outlets may be installed only if automatic means are provided to ensure that:

(a) liquid can flow from only one outlet at a time, and

(b) the direction of flow for which the mechanism may be set at any time is clearly and conspicuously indicated.

A manually controlled outlet that may be opened for purging or draining the measuring system or for recirculating product in suspension shall be permitted only when the system is measuring food products or agri-chemicals. Effective means shall be provided to prevent passage of liquid through any such outlet during normal operation of the measuring system and to inhibit meter indications (or advancement of indications) and recorded representations while the outlet is in operation.
(Amended 1991, 1995, and 1996)

S.3.2. Exceptions. - The provisions of S.3.1. Diversion Prohibited shall not apply to truck refueling devices when diversion of flow to other than the receiving vehicle cannot readily be accomplished and is readily apparent. Allowable deterrents include, but are not limited to, physical barriers to adjacent driveways, visible valves, or lighting systems that indicate which outlets are in operation, and explanatory signs.
(Amended 1982, 1990, 1991 and 2002)

S.3.3. Pump-Discharge Unit. - A pump-discharge unit equipped with a flexible discharge hose shall be of the wet-hose type.

S.3.4. Gravity-Discharge Unit. - On a gravity-discharge unit:

(a) the discharge hose or equivalent pipe shall be of the dry-hose type with no shutoff valve at its outlet end unless the hose or pipe drains to the same level under all conditions of use;

(b) the dry hose shall be sufficiently stiff and only as long as necessary to facilitate drainage;

(c) an automatic vacuum breaker, or equivalent mechanism, shall be incorporated to prevent siphoning and to ensure rapid and complete drainage; and

(d) the inlet end of the hose or outlet pipe shall be high enough to ensure complete drainage.

S.3.5. Discharge Hose, Reinforcement. - A discharge hose shall be reinforced so that the performance of the device is not affected by the expansion or contraction of the hose.

S.3.6. Discharge Valve. - A discharge valve may be installed in the discharge line only if the device is of the wet-hose type. Any other shutoff valve on the discharge side of the meter shall be of the automatic or semi-automatic predetermined-stop type or shall be operable only:

(a) by means of a tool (but not a pin) entirely separate from the device, or

(b) by mutilation of a security seal with which the valve is sealed open.

S.3.7. Antidrain Means. - In a wet-hose pressure-type device, means shall be incorporated to prevent the drainage of the discharge hose.
(Amended 1990)

S.4. Marking Requirements.

S.4.1. Limitation on Use. - The limitations on its use shall be clearly and permanently marked on any device intended to measure accurately only:

(a) products having particular properties; or

(b) under specific installation or operating conditions; or

(c) when used in conjunction with specific accessory equipment.

S.4.2. Air Pressure. - If a device is operated by air pressure, the air pressure gauge shall show by special graduations or other means the maximum and minimum working pressures recommended by the manufacturer.

S.4.3. Wholesale Devices.

S.4.3.1. Discharge Rates. - A wholesale device shall be marked to show its designed maximum and minimum discharge rates. However, the minimum discharge rate shall not exceed 20 percent of the maximum discharge rate.

S.4.3.2. Temperature Compensation. - If a device is equipped with an automatic temperature compensator, the primary indicating elements, recording elements, and recorded representation shall be clearly and conspicuously marked to show that the volume delivered has been adjusted to the volume at 15 °C (60 °F).

S.4.4. Retail Devices.

S.4.4.1. Discharge Rates. - *On a retail device with a designed maximum discharge rate of 115 L (30 gal) per minute or greater, the maximum and minimum discharge rates shall be marked on an exterior surface of the device and shall be visible after installation. The minimum discharge rate shall not exceed 20 percent of the maximum discharge rate.*
[Nonretroactive as of January 1, 1985.]
(Added 1984) (Amended 2002)

S.4.4.2. Location of Marking Information; Retail Motor-Fuel Dispensers. – *The required marking information in the General Code, Paragraph G-S.1. shall appear as follows:*

(a) Placement of this information shall not be on a portion of the device that can be readily removed or interchanged without the use of a tool separate from the device.

(b) The information shall appear 24 inches to 60 inches from the base of the dispenser when placed on the outside of the device.

(c) When placed behind an access door or panel the information shall appear 24 inches to 60 inches from the base of the dispenser in a readily legible position. The use of a dispenser key shall not be considered a tool separate from the device.

[Nonretroactive as of January 1, 2003]
(Added 2002)

S.5. Totalizers for Retail Motor-Fuel Dispensers. - *Retail motor-fuel dispensers shall be equipped with a nonresettable totalizer for the quantity delivered through the metering device. [Nonretroactive as of January 1, 1995.]*
(Added 1993) (Amended 1994 and 1997)

N. Notes

N.1. Test Liquid.

N.1.1. Type of Liquid. - The liquid used for testing a liquid-measuring device shall be the type the device is used to measure, or another liquid with the same general physical characteristics.

N.1.2. Labeling. - Following the completion of a successful examination of a wholesale device, the weights and measures official should attach a label or tag indicating the type of liquid used during the test.

N.2. Volume Change. - Care shall be taken to minimize changes in volume of the test liquid due to temperature changes and evaporation losses.

N.3. Test Drafts.

N.3.1. Retail Piston-Type and Visible-Type Devices. – Test drafts shall include the full capacity delivery and each intermediate delivery for which the device is designed.

N.3.2. Slow Flow Meters. - Test drafts shall be equal to at least four times the minimum volume that can be measured and indicated through either a visible indication or an audible signal.

N.3.3. Lubricant Devices. - Test drafts shall be 1 L (1 qt). Additional test drafts may include 0.5 L (1 pt), 4 L (4 qt), and 6 L (6 qt).

N.3.4. Other Retail Devices. - On devices with a designed maximum discharge rate of:

(a) less than 80 L (20 gal) per minute, tests shall include drafts of one or more amounts, including a draft of at least 19 liters (5 gal).

(b) 80 L (20 gal) per minute or greater, tests shall include drafts of one or more amounts, including a draft of at least the amount delivered by the device in one minute at the maximum flow rate of the installation. (Amended 1984)

N.3.5. Wholesale Devices. - The delivered quantity should be equal to at least the amount delivered by the device in one minute at its maximum discharge rate, and shall in no case be less than 200 L (50 gal).
(Amended 1987 and 1996)

N.4. Testing Procedures.

N.4.1. Normal Tests. - The "normal" test of a device shall be made at the maximum discharge flow rate developed under the conditions of installation. Any additional tests conducted at flow rates down to and including one-half of the sum of the maximum discharge flow rate and the rated minimum discharge flow rate shall be considered normal tests.
(Amended 1991)

N.4.1.1. Wholesale Devices Equipped with Automatic Temperature-Compensating Systems.

[NOT ADOPTED]

N.4.1.2. Repeatability Tests. - Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors, such as temperature, pressure, and flow rate are reduced to the extent that they will not affect the results obtained.
(Added 2001)

4002.8. Liquid-Measuring Devices. (3.30.)

(a) Wholesale Devices Equipped With Automatic Temperature Compensating Systems. On wholesale devices equipped with automatic temperature compensating systems, normal tests:

(1) shall be conducted with the temperature compensating system connected and operating by comparing the compensated volume indicated or recorded to the actual delivered volume corrected to 60°F, and

(2) may be conducted with the temperature compensating system deactivated by comparing the uncompensated volume indicated or recorded to the actual delivered volume.

The first test shall be performed with the automatic temperature compensating system operating in the "as found" condition.

On devices that indicate or record both the compensated and uncompensated volume for each delivery, the tests in (1) and (2) may be performed as a single test.

N.4.2. Special Tests. - "Special" tests, to develop the operating characteristics of a liquid-measuring device and any special elements and accessories attached to or associated with the device, shall be made as circumstances require. Any test except as set forth in N.4.1. shall be considered a special test.

N.4.2.1. Slow-Flow Meters. - A "special" test shall be made at a flow rate:

(a) not larger than twice the actual minimum flow rate, and

(b) not smaller than the actual minimum flow rate of the installation.

N.4.2.2. Retail Motor-Fuel Devices.

(a) Devices with a flow-rate capacity less than 100 (25 gal) per minute shall have a "special" test performed at the slower of the following rates:

(1) 19 L (5 gal) per minute, or

(2) the minimum discharge rate marked on the device, or

(3) the minimum discharge rate at which the device will deliver when equipped with an automatic discharge nozzle set at its slowest setting.

(b) Devices marked with a flow-rate capacity 100 L (25 gal) or more per minute, shall have a "special" test performed at the slowest of the following rates:

(1) the minimum discharge rate marked on the device, or

(2) the minimum discharge rate at which the device will deliver when equipped with an automatic discharge nozzle set at its slowest setting.
(Added 1984)

N.4.2.3. Other Retail Devices. - "Special" tests of other retail devices shall be made at the slower of the following rates:

(a) 50 percent of the maximum discharge rate developed under the conditions of installation, or

(b) the minimum discharge rate marked on the device.

N.4.2.4. Wholesale Devices. - "Special" tests shall be made to develop the operating characteristics of a measuring system and any special associated or attached elements and accessories. "Special" tests shall include a test at the slower of the following rates:

(a) 20 percent of the marked maximum discharge rate; or

(b) the minimum discharge rate marked on the device.

N.4.3. Money-Value Computation Tests.

N.4.3.1. Laboratory Tests. - When testing the device in the laboratory:

(a) compliance with paragraph S.1.6.5., Money Value Computations, shall be determined by using the cone gear as a reference for the total quantity delivered;

(b) the indicated quantity shall agree with the cone gear representation with the index of the indicator within the width of the graduation; and

(c) the maximum allowable variation of the indicated sales price shall be as shown in Table 1.

(Amended 1984)

N.4.3.2. Field Tests. - In the conduct of field tests to determine compliance with paragraph S.1.6.5., the maximum allowable variation in the indicated sales price shall be as shown in Table 1.
(Added 1982; Amended 1984)

N.5. Temperature Correction on Wholesale Devices. - Corrections shall be made for any changes in volume resulting from the differences in liquid temperatures between time of passage through the meter and time of volumetric determination in the prover. When adjustments are necessary, appropriate petroleum measurement tables should be used.
(Amended 1974)

T. Tolerances

T.1. Application to Underregistration and to Over-registration. The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of over-registration, whether or not a device is equipped with an automatic temperature compensator.

T.2. Tolerance Values. - Maintenance, Acceptance, and Special Test Tolerances shall be as shown in Table T.2.
(Amended 2002)

Table T.2. Accuracy Classes for Liquid Measuring Devices Covered in NIST Handbook 44 Section 3.30

Accuracy Class	Application	Acceptance Tolerance	Maintenance Tolerance	Special Test Tolerance
0.3	Petroleum products including large capacity motor fuel devices (flow rates over 115 L/min (30 gpm))**, heated products at or greater than 50 °C asphalt at or below temperatures 50 °C, all other liquids not shown where the typical delivery is over 200 L (50 gal).	0.2 %	0.3 %	0.5 %
0.3A	Asphalt at temperatures greater than 50 °C.	0.3 %	0.3 %	0.5 %
0.5*	Petroleum products delivered from small capacity (at 4 L/min (1 gpm) through 115 L/min (30 gpm))** motor-fuel devices, agri-chemical liquids, and all other applications not shown.	0.3 %	0.5 %	0.5%
1.1	Petroleum products and other normal liquids from devices with flow rates** less than 1 gpm and devices designed to deliver less than one gallon.	0.75 %	1.0 %	1.25%

* The maintenance tolerances on normal and special tests for 5-gallon and 10-gallon test drafts are 6 cubic inches and 11 cubic inches, respectively. Acceptance tolerances on normal and special tests are 3 cubic inches and 5.5 cubic inches.
** Flow rate refers to designed or marked maximum flow rate.

(Added 2002)

T.3. Repeatability. - When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 percent of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. This tolerance does not apply to the test of the automatic temperature compensating system. See also N.4.1.2.
(Added 1992) (Amended 2001 and 2002)

T.4. Automatic Temperature Compensating Systems. - *The difference between the meter error (expressed as a percentage) for results determined with and without the automatic temperature compensating system activated shall not exceed:*

(a) 0.2 percent for mechanical automatic temperature compensating systems; and

(b) 0.1 percent for electronic automatic temperature compensating systems.

The delivered quantities for each test shall be approximately the same size. The results of each test shall be within the applicable acceptance or maintenance tolerance.
[Nonretroactive as of January 1, 1988.]
(Added 1987) (Amended 1992, 1996 and 2002)

UR. User Requirements

UR.1. Selection Requirements.

UR.1.1. Discharge Hose.

UR.1.1.1. Length. - The length of the discharge hose on a retail motor-fuel device:

(a) shall be measured from its housing or outlet of the discharge line to the inlet of the discharge nozzle;

(b) shall be measured with the hose fully extended if it is coiled or otherwise retained or connected inside a housing; and

(c) shall not exceed 5.5 m (18 ft) unless it can be demonstrated that a longer hose is essential to permit deliveries to be made to receiving vehicles or vessels.

An unnecessarily remote location of a device shall not be accepted as justification for an abnormally long hose.
(Amended 1972 and 1987)

UR.1.1.2. Marinas and Airports.

UR.1.1.2.1. Length. - The length of the discharge hose shall be as short as practicable, and shall not exceed 15 m (50 ft) unless it can be demonstrated that a longer hose is essential.

UR.1.1.2.2. Protection. - Discharge hoses exceeding 8 m (26 ft) in length shall be adequately protected from weather and other environmental factors when not in use.
(Made retroactive 1974 and amended 1984)

UR.2. Installation Requirements.

UR.2.1. Manufacturer's Instructions. - A device shall be installed in accordance with the manufacturer's instructions, and the installation shall be sufficiently secure and rigid to maintain this condition.
(Added 1987)

UR.2.2. Discharge Rate. - A device shall be installed so that the actual maximum discharge rate will not exceed the rated maximum discharge rate. Automatic means for flow regulation shall be incorporated in the installation if necessary.

UR.2.3. Suction Head. - A piston-type device shall be installed so that the total effective suction head will not be great enough to cause vaporization of the liquid being dispensed under the highest temperature and lowest barometric pressure likely to occur.

UR.2.4. Diversion of Liquid Flow. - A motor-fuel device equipped with two delivery outlets used exclusively in the fueling of trucks shall be so installed that any diversion of flow to other than the receiving vehicle cannot be readily accomplished and is readily apparent. Allowable deterrents include, but are not limited to, physical barriers to adjacent driveways, visible valves, or lighting systems that indicate which outlets are in operation, and explanatory signs.
(Amended 1991)

UR.2.5. Product Storage Identification.

(a) The fill connection for any petroleum product storage tank or vessel supplying motor-fuel devices shall be permanently, plainly, and visibly marked as to product contained.

(b) When the fill connection device is marked by means of a color code, the color code key shall be conspicuously displayed at the place of business.
(Added 1975 and amended 1976)

UR.3. Use of Device.

UR.3.1. Return of Indicating and Recording Elements to Zero. - On any dispenser used in making retail deliveries, the primary indicating element, and recording element if so equipped, shall be returned to zero before each delivery.

Exceptions to this requirement are totalizers on key-lock-operated or other self-operated dispensers and the primary recording element if the device is equipped to record.

UR.3.2. Unit Price and Product Identity.

(a) The following information shall be conspicuously displayed or posted on the face of a retail dispenser used in direct sale:

(1) except for dispensers used exclusively for fleet sales, other price contract sales, and truck refueling (e.g., truck stop dispensers used only to refuel trucks), all of the unit prices at which the product is offered for sale; and

(2) in the case of a computing type or money-operated type, the unit price at which the dispenser is set to compute.

Provided that the dispenser complies with S.1.6.4.1., it is not necessary that all the unit prices for all grades, brands, blends, or mixtures be simultaneously displayed or posted.

(b) The following information shall be conspicuously displayed or posted on each side of a retail dispenser used in direct sale:

(1) the identity of the product in descriptive commercial terms, and

(2) the identity of the grade, brand, blend, or mixture that a multi-product dispenser is set to deliver.
(Amended 1972, 1983, 1987, 1989, 1992, and 1993)

UR.3.3. Computing Device.

(a) Any computing device used in an application where a product or grade is offered for sale at more than one unit price (excluding fleet sales and other price contract sales), shall be used only for sales for which the device computes and displays the sales price for the selected transaction.
[Became Retroactive 1999]
(Added 1989) (Amended 1992 and 2000)

(b) A truck stop dispenser used exclusively for refueling trucks is exempt from the requirements in (a) and (b) if all purchases of fuel are accompanied by a printed receipt of the transaction containing the applicable price per gallon, the total gallons delivered, and the total price of the sale.
(Added 1993)

(c) Unless a truck stop dispenser used exclusively for refueling trucks complies with S.1.6.4.1. (Display of Unit Price), the price posted on the dispenser and the price at which the dispenser is set to compute shall be the highest price for any transaction which may be conducted.
(Added 1993)

UR.3.4. Printed Ticket. - The total price, the total volume of the delivery, and the price per gallon or liter shall be shown, either printed or in clear hand script, on any printed ticket issued by a device and containing any one of these values.
(Amended 2001)

UR.3.5. Steps After Dispensing. - After delivery to a customer from a retail motor-fuel device:

(a) the starting lever shall be returned to its shutoff position and the zero-set-back interlock engaged; and

(b) the discharge nozzle shall be returned to its designed hanging position unless the primary indicating elements, and recording elements if the device is equipped and activated to record, have been returned to a definite zero indication.

UR.3.6. Temperature Compensation, Wholesale.

UR.3.6.1. Automatic.

UR.3.6.1.1. When to be Used. - If a device is equipped with a mechanical automatic temperature compensator, it shall be connected, operable, and in use at all times. An electronic or mechanical automatic temperature compensating system may not be removed, nor may a compensated device be replaced with an uncompensated device, without the written approval of the responsible weights and measures jurisdiction.

[Note: This requirement does not specify the method of sale for product measured through a meter.]
(Amended 1989)

UR.3.6.1.2. Invoices.

(a) A written invoice based on a reading of a device that is equipped with an automatic temperature compensator shall show that the volume delivered has been adjusted to the volume at 15 °C (60 °F).

(b) The invoice issued from an electronic wholesale device equipped with an automatic temperature compensating system shall also indicate: (1) the API gravity, specific gravity or coefficient of expansion for the product; (2) product temperature; and (3) gross reading.

(Amended 1987)

UR.3.6.2. Nonautomatic.

UR.3.6.2.1. Temperature Determination. - If the volume of the product delivered is adjusted to the volume at 15 °C (60 °F), the product temperature shall be taken during the delivery in:

(a) the liquid chamber of the meter, or

(b) the meter inlet or discharge line adjacent to the meter, or

(c) the compartment of the receiving vehicle at the time it is loaded.

UR.3.6.2.2. Invoices. - The accompanying invoice shall indicate that the volume of the product has been adjusted for temperature variations to a volume at 15 °C (60 °F) and shall also state the product temperature used in making the adjustment.

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S.2.2. Provision for Sealing. - Except on devices for metering milk, adequate provision shall be made for applying security seals in such a manner that no adjustment may be made of:

(a) any measurement element, and

(b) any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries.

S.2.2.1. Milk-Metering Systems. - Adequate provision shall be made for applying security seals to the adjustment mechanism and the register. The adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

S.2.3. Directional Flow Valves. - Valves intended to prevent reversal of flow shall be automatic in operation. However, on equipment used exclusively for fueling aircraft, such valves may be manual in operation.

S.3. Design of Discharge Lines and Discharge Line Valves. (Not applicable to milk-metering systems.)

S.3.1. Diversion of Measured Liquid. - Except on equipment used exclusively for fueling aircraft, no means shall be provided by which any measured liquid can be diverted from the measuring chamber of the meter or the discharge line therefrom. However, two or more delivery outlets may be installed if means is provided to insure that:

(a) liquid can flow from only one such outlet at one time, and

(b) the direction of flow for which the mechanism may be set at any time is definitely and conspicuously indicated.

S.3.2. Pump-Discharge Unit. - On a pump-discharge unit, the discharge hose shall be of the wet-hose type with a shutoff valve at its outlet end. However, a pump-discharge unit may be equipped also with a dry hose without a shutoff valve at its outlet end, but only if:

(a) the dry hose is as short as practicable, and

(b) there is incorporated in the discharge piping, immediately adjacent to the meter, effective means to insure that liquid can flow through only one of the discharge hoses at any one time and that the meter and the wet hose remain full of liquid at all times.

S.3.3. Gravity-Discharge Unit. - On a gravity-discharge unit, the discharge hose or equivalent pipe shall be of the dry-hose type with no shutoff valve at its outlet end. The dry hose shall be of such stiffness and only of such length as to facilitate its drainage. The inlet end of the hose or of an equivalent outlet pipe shall be of such height as to provide for proper drainage of the hose or pipe. There shall be incorporated an automatic vacuum breaker or equivalent means to prevent siphoning and to insure the rapid and complete drainage.

S.3.4. Discharge Hose. - A discharge hose shall be adequately reinforced.

S.3.5. Discharge Valve. - A discharge valve may be installed in the discharge line only if the device is of the wet-hose type, in which case such valve shall be at the discharge end of the line. Any other shutoff valve on the discharge side of the meter shall be of the automatic or semiautomatic predetermined-stop type or shall be operable only:

(a) by means of a tool (but not a pin) entirely separate from the device, or

(b) by mutilation of a security seal with which the valve is sealed open.

S.3.6. Antidrain Valve. - In a wet-hose, pressure-type device, an effective antidrain valve shall be incorporated in the discharge valve or immediately adjacent thereto. The antidrain valve shall function so as to prevent the drainage of the discharge hose. However, a device used exclusively for fueling and defueling aircraft may be of the pressure type without an antidrain valve.

S.4. Design of Intake Lines (for Milk-Metering Systems).

S.4.1. Diversion of Liquid to be Measured. - No means shall be provided by which any liquid can be diverted from the supply tank to the receiving tank without being measured by the device.

S.4.2. Intake Hose. - The intake hose shall be:

(a) of the dry-hose type;

(b) adequately reinforced;

(c) not more than 6 m (20 ft) in length, unless it can be demonstrated that a longer hose is essential to permit pickups from a supply tank; and

(d) connected to the pump at horizontal or above, to permit complete drainage of the hose.

S.5. Marking Requirements

S.5.1. Limitation of Use. - If a meter is intended to measure accurately only liquids having particular properties, or to measure accurately only under specific installation or operating conditions, or to measure accurately only when used in conjunction with specific accessory equipment, these limitations shall be clearly and permanently stated on the meter.

S.5.2. Discharge Rates. - A meter shall be marked to show its designed maximum and minimum discharge rates. However, the minimum discharge rate shall not exceed 20 percent of the maximum discharge rate.

S.5.3. Measuring Components Milk-Metering System. All components that affect the measurement of milk that are disassembled for cleaning purposes shall be clearly and permanently identified with a common serial number.

S.5.4. Flood Volume, Milk-Metering System. - When applicable, the volume of product necessary to flood the system when dry shall be clearly, conspicuously, and permanently marked on the air eliminator.

S.5.5. Conversion Factor. - When the conversion factor of 1.03 kg/L (8.6 lb/gal) is used to convert the volume of milk to weight, the conversion factor shall be clearly marked on the primary indicating element and recorded on the delivery ticket.
(Added 1989)

N. Notes

N.1. Test Liquid.

(a) A measuring system shall be tested with the liquid to be commercially measured or with a liquid of the same general physical characteristics. Following a satisfactory examination, the weights and measures official should attach a seal or tag indicating the product used during the test.
(Amended 1975)

(b) A milk measuring system shall be tested with the type of milk to be measured when the accuracy of the system is affected by the characteristics of milk (e.g., positive displacement meters).
(Amended 1989)

N.2. Evaporation and Volume Change. - Care shall be exercised to reduce to a minimum, evaporation losses and volume changes resulting from changes in temperature of the test liquid.

N.3. Test Drafts. - Test drafts should be equal to at least the amount delivered by the device in 1 minute at its maximum discharge rate, and shall in no case be less than 180 L (50 gal) or 225 kg (500 lb).
(Amended 1989)

N.4. Testing Procedures

N.4.1. Normal Tests. - The "normal" test of a measuring system shall be made at the maximum discharge rate that may be anticipated under the conditions of the installation. Any additional tests conducted at flow rates down to and including one-half of the sum of the maximum discharge flow rate and the rated minimum discharge flow rate shall be considered normal tests.
(Amended 1992)

N.4.1.1. Milk Measuring System. - The "normal" test shall include a determination of the effectiveness of the air elimination system.

N.4.1.2. Repeatability Tests. - Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors such as, temperature pressure and flow rate are reduced to the extent that they will not affect the results obtained.
(Added 2001)

N.4.2. Special Tests (Except Milk-Measuring Systems). "Special" tests shall be made to develop the operating characteristics of a measuring system and any special elements and accessories attached to or associated with the device. Any test except as set forth in N.4.1. shall be considered a special test. Special test of a measuring system shall be made as follows:

(a) at a minimum discharge rate of 20 percent of the marked maximum discharge rate or at the minimum discharge rate marked on the device whichever is less;

(b) to develop operating characteristics of the measuring system during a split-compartment delivery.
(Amended 1978)

N.4.3. Antidrain Valve Test. - The effectiveness of the antidrain valve shall be tested after the pump pressure in the measuring system has been released and a valve between the supply tank and the discharge valve is closed.

N.4.4. System Capacity. - The test of a milk-measuring system shall include the verification of the volume of product necessary to flood the system as marked on the air eliminator.

T. Tolerances

T.1. Application.

T.1.1. To Underregistration and to Overregistration. The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of overregistration.

T.2. Tolerance Values. – Maintenance, acceptance, and special test tolerances shall be as shown in Tables 1 and 2.
(Amended 1995 and 2002)

Tolerances, Table 1. Accuracy Classes for Vehicle-Tank Meters					
Accuracy Class	**Application**		**Acceptance Tolerance**	**Maintenance Tolerance**	**Special Test Tolerance**
0.3	Petroleum products including large capacity motor fuel devices (flow rates over 115 L/min (30 gpm))**, heated products at or greater than 50 °C asphalt at or below temperatures 50 °C, all other liquids not shown where the typical delivery is over 200 L (50 gal).		0.15 %	0.3 %	0.45 %
0.3A	Asphalt at temperatures greater than 50 °C.		0.3 %	0.3 %	0.5 %
0.5*	Petroleum products delivered from small capacity (at 4 L/min (1 gpm) through 115 L/min (30 gpm))** motor-fuel devices, agri-chemical liquids, and all other applications not shown.		0.3 %	0.5 %	0.5 %
1.1	Petroleum products and other normal liquids from devices with flow rates** less than 1 gpm and devices designed to deliver less than one gallon.		0.75 %	1.0 %	1.25 %
1.5	Water	Overregistration	1.5 %	1.5 %	1.5 %
		Underregistration	1.5 %	1.5 %	5.0 %

* The maintenance tolerances on normal and special tests for 5-gallon and 10-gallon test drafts are 6 cubic inches and 11 cubic inches, respectively. Acceptance tolerances on normal and special tests are 3 cubic inches and 5.5 cubic inches.

** Flow rate refers to designed or marked maximum flow rate.

(Added 2002)

Table 2. Tolerances for Vehicle-Mounted Milk Meters		
Indication	Maintenance	Acceptance
gallons	gallons	gallons
100	0.5	0.3
200	0.7	0.4
300	0.9	0.5
400	1.1	0.6
500	1.3	0.7
Over 500	Add 0.002 gallon per indicated gallon over 500	Add 0.001 gallon per indicated gallon over 500

*(Added 1989)

T.3. Repeatability. - When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 percent absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. See also N.4.1.2.
(Added 1992) (Amended 2001 and 2002)

UR. User Requirements

UR.1. Installation Requirements.

UR.1.1. Discharge Rate. - A meter shall be so installed that the actual maximum discharge rate will not exceed the rated maximum discharge rate. If necessary, means for flow regulation shall be incorporated in the installation, in which case this shall be fully effective and automatic in operation.

UR.1.2. Unit Price. - There shall be displayed on the face of a device of the computing type the unit price at which the device is set to compute.

UR.1.3. Intake Hose. - The intake hose in a milk-metering system shall be installed to permit complete drainage and ensure that all available product is measured following each pickup.

UR.2. Use Requirements.

UR.2.1. Return of Indicating and Recording Elements to Zero. - The primary indicating elements (visual), and the primary recording elements, when these are returnable to zero, shall be returned to zero immediately before each delivery is begun and after the pump has been activated and the product to be measured has been supplied to the measuring system.
(Amended 1981)

UR.2.2. Ticket Printer; Customer Ticket.
[NOT ADOPTED]

Section 4002.3. Vehicle-Tank Meters. (3.31.)

UR.2.2. Ticket Printer; Customer Ticket. Vehicle-mounted metering systems shall be equipped with a ticket printer which shall be used for all sales where product is delivered through the meter. A copy of the ticket issued by the device shall be left with the customer at the time of delivery or as otherwise specified by the customer. [Nonretroactive as of January 1, 1995.]

UR.2.2.1. Exceptions for the Sale of Aviation Fuel. - The provisions of UR.2.2. Ticket Printer; Customer Ticket shall not apply to vehicle-mounted metering systems used solely for the sale of aviation fuel into aircraft and for aircraft-related operations.
(Added 1999)

UR.2.3. Ticket in Printing Device. - A ticket shall not be inserted into a device equipped with a ticket printer until immediately before a delivery is begun, and in no case shall a ticket be in the device when the vehicle is in motion while on a public street, highway, or thoroughfare.

UR.2.4. Credit for Flood Volume. - The volume of product necessary to flood the system as marked on the air eliminator shall be individually recorded on the pickup ticket of each seller affected.

S.4. Marking Requirements.

S.4.1. Limitations of Use. - If a device is intended to measure accurately only products having particular properties, or to measure accurately only under specific installation or operating conditions, or to measure accurately only when used in conjunction with specific accessory equipment, these limitations shall be clearly and permanently stated on the device.

S.4.2. Discharge Rates. - A volume-measuring device shall be marked to show its rated gas capacity in cubic meters per hour or cubic feet per hour.
(Amended 1973, 1991)

S.4.3. Temperature Compensation.
[NOT ADOPTED]

4002.5. Hydrocarbon Gas Vapor-Measuring Devices. (3.33.)

(b) Temperature Compensation. - If a device is equipped with an automatic temperature compensator, this shall be indicated on the badge or immediately adjacent to the badge of the device and on the register.

S.4.4. Badge. - A badge affixed in a prominent position on the front of the device shall show the manufacturer's name, serial number and model number of the device, and capacity rate of the device for the particular products that it was designed to meter as recommended by the manufacturer.

N. Notes

N.1. Test Medium. - The device shall be tested with air or the product to be measured.
(Amended 1991)

N.2. Temperature and Volume Change. - Care should be exercised to reduce to a minimum any volume changes. The temperature of the air, bell-prover oil, and the meters under test should be within 1 °C (2 °F) of one another. The devices should remain in the proving room for at least 16 hours before starting any proving operations to allow the device temperature to approximate the temperature of the proving device.

N.3. Test Drafts. - Except for low-flame tests, test drafts shall be at least equal to one complete revolution of the largest capacity proving indicator, and shall in no case be less than 0.05 m^3 or 2 ft^3. All flow rates shall be controlled by suitable outlet orifices.
(Amended 1973 and 1990)

N.4. Test Procedures. - If a device is equipped with an automatic temperature compensator, the proving device reading shall be corrected to 15 °C (60 °F), using an approved table.
(Amended 1972)

N.4.1. Normal Tests. - The normal test of a device shall be made at a rate not to exceed the capacity rate given on the badge of the meter.
(Amended 1988)

N.4.1.1. Automatic Temperature Compensation. If a device is equipped with an automatic temperature compensator, the quantity of the test draft indication of the standard shall be corrected to 15 °C (60 °F).

N.4.1.2. Repeatability Tests. – Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors, such as temperature pressure, and flow rate are reduced to the extent that they will not affect the results obtained.
(Added 2002)

N.4.2. Special Tests. - "Special" tests, to develop the operating characteristics of a device, and any special elements and accessories attached to or associated with the device, shall be made as circumstances require. Any test except as set forth in N.4.1. is a special test.

N.4.2.1. Slow Test. - The device shall be tested at a rate not less than 20 percent of the marked capacity rate, or (at the check rate) not less than the minimum flow rate if marked on the device, whichever is less.
(Amended 1988)

N.4.2.2. Low-Flame Test. - The device shall be tested at an extremely low-flow rate as given in Table 1. The test shall consist of passing air at a pressure of 375 Pa (1.5 in water column) through the meter for not less than 60 minutes. The meter shall continue to advance at the conclusion of the test period.
(Amended 1990, 1991)

N.4.2.3. Pressure Regulation Test. - On devices operating at a pressure of 6 900 Pa (1 psig) or more, a pressure regulation test shall be made at both the minimum and maximum use load to determine the proper operation of the regulator and the proper sizing of the piping and dispensing equipment. These tests may include a test of 24 hours during which the pressure is recorded.
(Added 1984)

Table 1.
Capacity of Low-Flow Test Rate Orifices
With Respect to Device Capacity

Metric Units		Inch-Pound Units	
Rated Capacity	Low-Flow Test Rate	Rated Capacity	Low-Flow Test Rate
Up to and including 7 m^3/h	0.007 m^3/h	Up to and including 250 ft^3/h	0.25 ft^3/h
Over 7 m^3/h up to and including 14 m^3/h	0.014 m^3/h	Over 250 ft^3/h up to and including 500 ft^3/h	0.50 ft^3/h
Over 14 m^3/h	0.1% of capacity rate	Over 500 ft^3/h	0.1% of capacity rate

(Amended 1973)

N.5. Temperature Correction. - Corrections shall be made for any changes in volume resulting from the difference in air temperatures between time of passage through the device and time of volumetric determination in the proving device.

N.6. Frequency of Test. - A hydrocarbon gas vapor-measuring device shall be tested before installation and allowed to remain in service for 10 years from the time last tested without being retested, unless a test is requested by:

(a) the purchaser of the product being metered,

(b) the seller of the product being metered, or

(c) the weights and measures official.

4002.5. Hydrocarbon Gas Vapor-Measuring Devices. (3.33.)

(a) Leak Test. Each meter shall be submitted to a pressure leak test not to exceed the manufacturer's maximum rated pressure.

T. Tolerances

T.1. Tolerance Values on Normal Tests and on Special Tests Other Than Low-Flame Tests. - Maintenance and acceptance tolerances for hydrocarbon gas vapor-measuring devices shall be 3 percent (1.03 proof) of the test draft on underregistration and 1.5 percent (0.985 proof) of the test draft on overregistration.
(Amended 1981)

T.2. Repeatability – When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 0.9 percent and the results of each test shall be within the applicable tolerance. *See also N.4.1.2.*
(Added 2002)

UR. User Requirements

UR.1. Installation Requirements.

UR.1.1. Capacity Rate. - A device shall be so installed that the actual maximum flow rate will not exceed the capacity rate except for short durations. If necessary, means for flow regulation shall be incorporated in the installation, in which case this shall be fully effective and automatic in operation.

UR.1.2. Leakage. - The metering system shall be installed and maintained as a pressure-tight and leak-free system.

UR.2. Use Requirements.

UR.2.1. Automatic Temperature Compensation. - A compensated device may not be replaced with an uncompensated device without the written approval of the weights and measures authority having jurisdiction over the device.

UR.2.2. Invoices. - A customer purchasing hydrocarbon gas measured by a vapor meter for other than motor fuel shall receive from the seller an invoice for each billing period. The invoice shall clearly and separately show the following:

(a) The opening and closing meter readings and the dates of those readings.

(b) The altitude correction factor.

(c) The total cubic meters (cubic feet) billed, corrected for elevation.

(d) The charge per cubic meter (cubic foot) after correction for elevation.

(e) All periodic charges independent of the measured gas, such as meter charges, meter reading fees, service charges or a minimum charge for a minimum number of cubic meters (cubic feet).

(f) The total charge for the billing period.

If the vapor meter is equipped with an automatic temperature compensator, or any other means are used to compensate for temperature, the invoice shall show that the volume has been adjusted to the volume at 15 °C (60 °F).
(Amended 1988, 1991)

UR.2.3. Correction for Elevation. - The metered volume of gas shall be corrected for changes in the atmospheric pressure with respect to elevation to the standard pressure of 14.73 lb psia. The appropriate altitude correction factor from Table 2M or 2 shall be used. (The table is modified from NIST Handbook 117.)
(Amended 1988)

Elevation correction factors (ACF) were obtained by using the following equation:

$$ACF = \frac{GP \text{ of gas} + AAP}{\text{base pressure}}$$

where

GP = gauge pressure
AAP = assumed atmospheric pressure
base pressure = 101.560 kPa = 14.73 psia

2740 Pa = 11 in of water column = 0.397 psig

1744 Pa = 7 in of water column = 0.253 psig
(Added 1988)

UR.2.4. Valves and Test Tee. - *All gas meter installations shall be provided with a shut-off valve located adjacent to and on the inlet side of the meter. In the case of a single meter installation utilizing a liquefied petroleum gas tank, the tank service valve may be used in lieu of the shut-off valve. All gas meter installations shall be provided with a test tee located adjacent to and on the outlet side of the meter.*
[Nonretroactive as of January 1, 1990.]
(Added 1989)

UR.2.5. Use of Auxiliary Heated Vaporizer Systems. Automatic temperature compensation shall be used on hydrocarbon gas vapor meters equipped with an auxiliary heated vaporizer system unless there is sufficient length of underground piping to provide gas at a uniform temperature to the meter inlet. When required by weights and measures officials, a thermometer well (appropriately protected against freezing) shall be installed immediately up-stream of the meter.
(Added 1990)

4002.5. Hydrocarbon Gas Vapor-Measuring Devices. (3.33.)

(c) Retention of Customer Invoices. Any person engaging in the sale of hydrocarbon gas vapor shall retain a record of:

(1) each individual hydrocarbon gas vapor meter billing invoice, and

(2) the applicable rate schedule for a period of not less than 12 months and shall make them available at reasonable times for inspection and copying by the customer and the county sealer of weights and measures.

Table 2M. Corrections for Altitude, Metric Units							
Elevation (meters)			Altitude Correction Factor		Assumed Atmospheric Pressure	Assumed Atmospheric Pressure Plus Gauge Pressure	
			2.74 kPa Gauge Pressure	1.74 kPa Gauge Pressure	(kPa)	2.74 kPa Gauge Pressure	1.74 kPa Gauge Pressure
	-50 to	120	1.02	1.01	100.85	103.59	102.58
above	120 to	300	1.00	0.99	98.82	101.56	100.54
above	300 to	470	0.98	0.97	96.79	99.53	98.51
above	470 to	650	0.96	0.95	94.76	97.50	96.48
above	650 to	830	0.94	0.93	92.73	95.47	94.45
above	830 to	1020	0.92	0.91	90.70	93.44	92.42
above	1020 to	1210	0.90	0.89	88.66	91.40	90.39
above	1210 to	1400	0.88	0.87	86.63	89.37	88.36
above	1400 to	1590	0.86	0.85	84.60	87.34	86.33
above	1590 to	1790	0.84	0.83	82.57	85.31	84.29
above	1790 to	2000	0.82	0.81	80.54	83.28	82.26
above	2000 to	2210	0.80	0.79	78.51	81.25	80.23
above	2210 to	2420	0.78	0.77	76.48	79.22	78.20
above	2420 to	2640	0.76	0.75	74.45	77.19	76.17
above	2640 to	2860	0.74	0.73	72.41	75.15	74.15
above	2860 to	3080	0.72	0.71	70.38	73.12	72.12
above	3080 to	3320	0.70	0.69	68.35	71.09	70.08
above	3320 to	3560	0.68	0.67	66.32	69.06	68.05
above	3560 to	3800	0.66	0.65	64.29	67.03	66.01
above	3800 to	4050	0.64	0.63	62.26	65.00	63.98
above	4050 to	4310	0.62	0.61	60.23	62.97	61.95
above	4310 to	4580	0.60	0.59	58.20	60.94	59.92

Sec. 3.34. Cryogenic Liquid-Measuring Devices

A. Application

A.1. - This code applies to devices used for the measurement of cryogenic liquids such as, but not limited to oxygen, nitrogen, hydrogen, and argon.
(Amended 1986 and 1995)

A.2. - This code does not apply to the following:

(a) Devices used for dispensing liquefied petroleum gases (for which see Sec. 3.32; Code for Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices).

(b) Devices used solely for dispensing a product in connection with operations in which the amount dispensed does not affect customer charges.

(c) Devices used solely for dispensing liquefied natural gas.

(d) Mass flow meters (see Sec. 3.37. Code for Mass Flow Meters).
(Added 1994)

A.3. - See also Sec. 1.10; General Code requirements.

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

S.1.1. Primary Elements.

S.1.1.1. General. - A device shall be equipped with a primary indicating element and may also be equipped with a primary recording element.

S.1.1.2. Units. - A device shall indicate and record, if equipped to record, its deliveries in terms of: kilograms or pounds; liters or gallons of liquid at the normal boiling point of the specific cryogenic product; cubic meters (cubic feet) of gas at a normal temperature of 21 °C (70 °F) and an absolute pressure of 101.325 kPa (14.696 psia); or decimal subdivisions or multiples of the measured units cited above.
(Amended 1997 and 2002)

S.1.1.3. Value of Smallest Unit. - The value of the smallest unit of indicated delivery, and recorded delivery, if the device is equipped to record, shall not exceed the equivalent of:

(a) for small delivery devices

(1) 1 L
(2) 0.1 gal
(3) 1 kg
(4) 1 lb
(5) 0.1 m^3 of gas
(6) 10 cubic feet of gas

(b) for large delivery devices

(1) 10 L
(2) 1 gal
(3) 10 kg
(4) 10 lb
(5) 1 m^3 of gas
(6) 100 ft^3 of gas
(Amended 1997 and 2002)

S.1.1.4. Advancement of Indicating and Recording Elements. - Primary indicating and recording elements shall be susceptible to advancement only by the normal operation of the device. However, a device may be cleared by advancing its elements to zero, but only if:

(a) the advancing movement, once started, cannot be stopped until zero is reached, or

(b) in the case of indicating elements only, such elements are automatically obscured until the elements reach the correct zero position.

S.1.1.5. Return to Zero. - Primary indicating and recording elements shall be readily returnable to a definite zero indication. Means shall be provided to prevent the return of primary indicating elements and of primary recording elements beyond their correct zero position.

S.1.2. Graduations.

S.1.2.1. Length. - Graduations shall be so varied in length that they may be conveniently read.

S.1.2.2. Width. - In any series of graduations, the width of a graduation shall in no case be greater than the width of the minimum clear interval between graduations, and the width of main graduations shall be not more than 50 percent greater than the width of subordinate graduations. Graduations shall in no case be less than 0.2 mm (0.008 in) in width.

S.1.2.3. Clear Interval Between Graduations. - The clear interval shall be no less than 1.0 mm (0.04 in). If the graduations are not parallel, the measurement shall be made:

(a) along the line of relative movement between the graduations at the end of the indicator, or

(b) if the indicator is continuous, at the point of widest separation of the graduations. (See also S.1.3.6.)

S.1.3. Indicators.

S.1.3.1. Symmetry. - The index of an indicator shall be symmetrical with respect to the graduations, at least throughout that portion of its length associated with the graduations.

S.1.3.2. Length. - The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case the distance between the end of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 1.0 mm (0.04 in).

S.1.3.3. Width. - The width of the index of an indicator in relation to the series of graduations with which it is used shall be not greater than:

(a) *the width of the narrowest graduation*, and [*Nonretroactive as of January 1, 2002]* (Amended 2001)

(b) the width of the minimum clear interval between graduations.

When the index of an indicator extends along the entire length of a graduation, that portion of the index of the indicator that may be brought into coincidence with the graduation shall be of the same width throughout the length of the index that coincides with the graduation.

S.1.3.4. Clearance. - The clearance between the index of an indicator and the graduations shall in no case be more than 1.5 mm (0.06 in).

S.1.3.5. Parallax. - Parallax effect shall be reduced to the practicable minimum.

S.1.3.6. Travel of Indicator. - If the most sensitive element of the primary indicating element utilizes an indicator and graduations, the relative movement of these parts corresponding to the smallest indicated value shall be not less than 0.5 mm (0.20 in).

S.1.4. Computing-Type Device.

S.1.4.1. Printed Ticket. - Any printed ticket issued by a device of the computing type on which there is printed the total computed price shall have printed clearly thereon also the total quantity of the delivery and the price per unit.

S.1.4.2. Money-Value Computations. - Money-value computations shall be of the full-computing type in which the money value at a single unit price, or at each of a series of unit prices, shall be computed for every delivery within either the range of measurement of the device or the range of the computing elements, whichever is less. Value graduations shall be supplied and shall be accurately positioned. The total price shall be computed on the basis of the quantity indicated when the value of the smallest division indicated is equal to or less than the values specified in S.1.1.3.

S.1.4.3. Money-Values - Mathematical Agreement. Any digital money-value indication and any recorded money value on a computing type device shall be in mathematical agreement with its associated quantity indication or representa-tion to within one cent of money value.

S.2. Design of Measuring Elements.

S.2.1. Vapor Elimination. - A measuring system shall be equipped with an effective vapor eliminator or other effective means to prevent the measurement of vapor that will cause errors in excess of the applicable tolerances. (See Sec. T.)

S.2.2. Directional Flow Valves. - A valve or valves or other effective means, automatic in operation, to prevent the reversal of flow shall be installed in or adjacent to the measuring device.
(Amended 1978)

S.2.3. Maintenance of Liquid State. - A device shall be so designed that the product being measured will remain in a liquid state during passage through the device.

S.2.4. Automatic Temperature or Density Compensation. - A device shall be equipped with automatic means for adjusting the indication and/or recorded representation of the measured quantity of the product, to indicate and/or record in terms of: kilograms or pounds; or liters or gallons of liquid at the normal boiling point of the specific cryogenic product; or the equivalent cubic meters (cubic feet) of gas at a normal temperature of 21 °C (70 °F) and an absolute pressure of 101.325 kPa

(14.696 lb/in^2 absolute). *When a compensator system malfunctions, the indicating and recording elements may indicate and record in uncompensated volume if the mode of operation is clearly indicated, e.g., by a marked annunciator, recorded statement, or other obvious means.**
*[*Nonretroactive as of January 1, 1992.]*
(Amended 1991 and 2002)

S.2.5. Provision for Sealing. - Adequate provision shall be made for applying security seals in such a manner that no adjustment or interchange may be made of:

(a) any measurement element,

(b) any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries, and

(c) any automatic temperature or density compensating system.

Any adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

S.3. Design of Discharge Lines and Discharge Line Valves.

S.3.1. Diversion of Measured Liquid. - No means shall be provided by which any measured liquid can be diverted from the measuring chamber of the device or the discharge line therefrom, except that a manually controlled outlet that may be opened for purging or draining the measuring system shall be permitted. Effective means shall be provided to prevent the passage of liquid through any such outlet during normal operation of the device and to indicate clearly and unmistakably when the valve controls are so set as to permit passage of liquid through such outlet.

S.3.2. Discharge Hose. - The discharge hose of a measuring system shall be of the completely draining dry-hose type.

S.4. Level Condition, On-Board Weighing Systems. - Provision shall be made for automatically inhibiting the delivery of a cryogenic liquid when the vehicle is out-of-level beyond the limit required for the performance to be within applicable tolerance.
(Added 1986)

S.5. Marking Requirements.

S.5.1. Limitation of Use. - If a measuring system is intended to measure accurately only liquids having particular properties, or to measure accurately only under specific installation or operating conditions, or to measure accurately only when used in conjunction with specific accessory equipment, these limitations shall be clearly and permanently marked on the device.

S.5.2. Discharge Rates. - A meter shall be marked to show its designed maximum and minimum discharge rates.

S.5.3. Temperature or Density Compensation. - Devices equipped with an automatic temperature or density compensator, shall be clearly and conspicuously marked on the primary indicating elements, recording elements, and recorded representations to show that the quantity delivered has been adjusted to the conditions specified in S.2.4.

N. Notes

N.1. Test Liquid. - A meter shall be tested with the liquid to be commercially measured except that, in a type evaluation examination, nitrogen may be used.

N.2. Vaporization and Volume Change. - Care shall be exercised to reduce to a minimum vaporization and volume changes. When testing by weight, the weigh tank and transfer systems shall be precooled to liquid temperature prior to the start of the test to avoid the venting of vapor from the vessel being weighed.

N.3. Test Drafts.

N.3.1. Gravimetric Test. - Weight test drafts shall be equal to at least the amount delivered by the device in two minutes at its maximum discharge rate, and shall in no case be less than 907 kg (2 000 lb).

N.3.2. Transfer Standard Test. - When comparing a meter with a calibrated transfer standard, the test draft shall be equal to at least the amount delivered by the device in two minutes at its maximum discharge rate, and shall in no case be less than 180 L (50 gal) or equivalent thereof. When testing uncompensated volumetric meters in a continuous recycle mode, appropriate corrections shall be applied if product conditions are abnormally affected by this test mode.
(Amended 1976)

N.4. Density. - Temperature and pressure of the metered test liquid shall be measured during the test for the determination of density or volume correction factors when applicable. For Liquid Density and Volume Correction Factors (with respect to temperature and pressure) the following publication shall apply: "Thermophysical Properties of Fluids. 1. Argon, Ethylene, Parahydrogen, Nitrogen, Nitrogen Trifluoride, and Oxygen," published in the Journal of Physical and Chemical Reference Data, Volume 11, 1982, Supplement No. 1, and

published by the American Chemical Society and the American Institute of Physics for the National Institute of Standards and Technology.
(Amended 1986)

N.5. Testing Procedures.

N.5.1. Normal Tests. - The "normal" tests of a device shall be made over a range of discharge rates that may be anticipated under the conditions of installation.

N.5.1.1. Repeatability Tests. - Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors, such as, temperature pressure and flow rate are reduced to the extent that they will not affect the results obtained. (Added 2001)

N.5.2. Special Tests. - Any test except as set forth in N.5.1. shall be considered a "special" test. Tests shall be conducted, if possible, to evaluate any special elements or accessories attached to or associated with the device. A device shall be tested at a minimum discharge rate of:

(a) 50 percent of the maximum discharge rate developed under the conditions of installation, or the minimum discharge rate marked on the device, whichever is less, or

(b) the lowest discharge rate practicable under conditions of installation.

Special tests may be conducted to develop any characteristics of the device that are not normally anticipated under the conditions of installation as circumstances require.

N.6. Temperature Correction. - Corrections shall be made for any changes in volume resulting from the differences in liquid temperature between time of passage through the meter and time of volumetric determination of test draft.

N.7. Automatic Temperature or Density Compensation. When a device is equipped with an automatic temperature or density compensator, the compensator shall be tested by comparing the quantity indicated or recorded by the device (with the compensator connected and operating) with the actual delivered quantity corrected to the normal boiling point of the cryogenic product being measured or to the normal temperature and pressure as applicable.

T. Tolerances

T.1. Application.

T.1.1. To Underregistration and to Over-registration. The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of overregistration.

T.2. Tolerance Values.

T.2.1. On Normal Tests. - The maintenance tolerance on "normal" tests shall be two and one-half percent (2.5%) of the indicated quantity. The acceptance tolerance shall be one and one-half percent (1.5%) of the indicated quantity.

T.2.2. On Special Tests. - The maintenance and acceptance tolerance on "special" tests shall be two and one-half percent (2.5%) of the indicated quantity.

T.3. On Tests Using Transfer Standards. - To the basic tolerance values that would otherwise be applied, there shall be added an amount equal to two times the standard deviation of the applicable transfer standard when compared to a basic reference standard.
(Added 1976)

T.4. Repeatability. - When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 percent of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. See also N.5.1.1.
(Added 2001)

UR. User Requirements

UR.1. Installation Requirements.

UR.1.1. Discharge Rate. - A device shall be so installed that the actual maximum discharge rate will not exceed the rated maximum discharge rate. If necessary, means for flow regulation shall be incorporated in the installation.

UR.1.2. Length of Discharge Hose. - The discharge hose shall be of such a length and design as to keep vaporization of the liquid to a minimum.

UR.1.3. Maintenance of Liquid State. - A device shall be so installed and operated that the product being measured shall remain in the liquid state during passage through the meter.

UR.2. Use Requirements.

UR.2.1. Return of Indicating and Recording Elements to Zero. - The primary indicating elements (visual) and the primary recording elements shall be returned to zero immediately before each delivery.

UR.2.2. Condition of Discharge System. - The discharge system, up to the measuring element, shall be pre-cooled to liquid temperatures before a "zero" condition is established prior to the start of a commercial delivery.

from the supply tank to the receiving tank without being measured by the device. A manually controlled outlet that may be opened for purging or draining the measuring system shall be permitted. Effective means shall be provided to prevent passage of liquid through any such outlet during normal operation of the measuring system.
(Amended 1994)

S.3.2. Intake Hose. - The intake hose shall be:

(a) of the dry-hose type,

(b) adequately reinforced,

(c) not more than 6 m (20 ft) in length unless it can be demonstrated that a longer hose is essential to permit transfer from a supply tank; and

(d) connected to the pump at horizontal or above to permit complete drainage of the hose.
(Amended 1991)

S.4. Marking Requirements.

S.4.1. Limitation of Use. - If a meter is intended to measure accurately only liquids having particular properties, or to measure accurately only under specific installation or operating conditions, or to measure accurately only when used in conjunction with specific accessory equipment, these limitations shall be clearly and permanently stated on the meter.

S.4.2. Discharge Rates. - A meter shall be marked to show its designed maximum and minimum discharge rates. However, the minimum discharge rate shall not exceed 20 percent of the maximum discharge rate.

S.4.3. Measuring Components. - All components that affect the measurement of milk that are disassembled for cleaning purposes shall be clearly and permanently identified with a common serial number.

S.4.4. Flood Volume. - When applicable, the volume of product (to the nearest minimum division of the meter) necessary to flood the system when dry shall be clearly, conspicuously, and permanently marked on the air eliminator.

S.4.5. Conversion Factor. - When the conversion factor of 1.03 kg/L (8.6 lb/gal) is used to convert the volume of milk to weight, the conversion factor shall be clearly marked on the primary indicating element and recorded on the delivery ticket.

N. Notes

N.1. Test Liquid.

(a) A meter shall be tested with the liquid to be commercially measured or with a liquid of the same general physical characteristics. Following a satisfactory examination, the weights and measures official should attach a seal or tag indicating the product used during the test.
(Amended 1989)

(b) A milk measuring system shall be tested with the type of milk to be measured when the accuracy of the system is affected by the characteristics of milk (e.g., positive displacement meters).
(Added 1989)

N.2. Evaporation and Volume Change. - Care shall be exercised to reduce to a minimum, evaporation losses and volume changes resulting from changes in temperature of the test liquid.

N.2.1. Temperature Correction. - Corrections shall be made for any changes in volume resulting from the differences in liquid temperatures between time of passage through the meter and time of volumetric determination in the test measure. When adjustments are necessary, appropriate tables should be used.

N.3. Test Drafts. - Test drafts should be equal to at least the amount delivered by the device in one minute at its maximum discharge rate, and shall in no case be less than 400 L or 400 kg (100 gal or 1 000 lb).
(Amended 1989)

N.4. Testing Procedures.

N.4.1. Normal Tests. - The "normal" test of a meter shall be made at the maximum discharge rate that may be anticipated under the conditions of the installation. The "normal" test shall include a determination of the effectiveness of the air elimination system.

N.4.1.1. Repeatability Tests. – Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors, such as temperature, pressure, and flow rate are reduced to the extent that they will not affect the results obtained.
(Added 2002)

N.4.2. Special Tests. - "Special" tests to develop the operating characteristics of a meter and any special elements and accessories attached to or associated with the meter, shall be made as circumstances require. Any test except as set forth in N.4.1. shall be considered a special test.

N.4.3. System Capacity. - The test of a milk-metering system shall include the verification of the volume of product necessary to flood the system as marked on the air eliminator.

T. Tolerances

T.1. Application.

T.1.1. To Underregistration and to Overregistration. The tolerances hereinafter prescribed shall be applied to errors of underregistration and errors of overregistration.

T.2. Tolerance Values. - Maintenance and acceptance tolerances shall be as shown in Table 1.
(Amended 1989)

Table 1. Tolerances

Milk Meters		
Indication	Maintenance	Acceptance
gallons	gallons	gallons
100	0.5	0.3
200	0.7	0.4
300	0.9	0.5
400	1.1	0.6
500	1.3	0.7
Over 500	Add 0.002 gallon per indicated gallon over 500	Add 0.001 gallon per indicated gallon over 500

*Added 1989

T.3. Repeatability – When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 percent of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. See also N.4.1.1.
(Added 2002)

UR. User Requirements

UR.1. Installation Requirements.

UR.1.1. Plumb and Level Condition. - A device installed in a fixed location shall be installed plumb and level, and the installation shall be sufficiently strong and rigid to maintain this condition.

UR.1.2. Discharge Rate. - A meter shall be so installed that the actual maximum discharge rate will not exceed the rated maximum discharge rate. If necessary, means for flow regulation shall be incorporated in the installation, in which case this shall be fully effective and automatic in operation.

UR.1.3. Unit Price. - There shall be displayed on the face of a device of the computing type the unit price at which the device is set to compute.

UR.1.4. Intake Hose. - The intake hose shall be so installed as to permit complete drainage and that all available product is measured following each transfer.

UR.2. Use Requirements.

UR.2.1. Return of Indicating and Recording Elements to Zero. - The primary indicating elements (visual), and the primary recording elements when these are returnable to zero, shall be returned to zero before each transfer.

UR.2.2. Printed Ticket. - Any printed ticket issued by a device of the computing type on which there is printed the total computed price, the total quantity, or the price per unit of quantity, shall also show the other two values (either printed or in clear script).
(Amended 1989)

UR.2.3. Ticket in Printing Device. - A ticket shall not be inserted into a device equipped with a ticket printer until immediately before a transfer is begun. If the meter is mounted on a vehicle, in no case shall a ticket be in the device when the vehicle is in motion while on a public street, highway, or thoroughfare.

UR.2.4. Credit for Flood Volume. - The volume of product necessary to flood the system as marked on the air eliminator shall be individually recorded on the ticket of each transfer affected.

Sec. 3.36. Water Meters

A. Application

A.1. This code applies to devices used for the measurement of water; generally applicable to, but not limited to, utilities type meters installed in residences or business establishments and meters installed in batching systems.
(Amended 2002)

A.2. This code does not apply to:

(a) water meters mounted on vehicle tanks (for which see Sec. 3.31. Code for Vehicle Tank Meters).

(b) mass flow meters (see Sec. 3.37. Code for Mass Flow Meters).
(Added 1994)

A.3. See also Sec. 1.10; General Code requirements.

S. Specifications

S.1. Design of Indicating and Recording Elements and of Recorded Representations.

S.1.1. Primary Elements.

S.1.1.1. General. A water meter shall be equipped with a primary indicating element and may also be equipped with a primary recording element. Such elements shall be visible at the point of measurement or be stored in non-volatile and nonresettable memory. The display may be remotely located provided it is readily accessible to the customer.
(Amended 2002)

S.1.1.2. Units. A water meter shall indicate and record, if the device is equipped to record, its deliveries in terms of liters, gallons or cubic feet or binary or decimal subdivisions thereof except batch plant meters, which shall indicate deliveries in terms of liters, gallons or decimal subdivisions of the liter or gallon only.

S.1.1.3. Value of Smallest Unit. The value of the smallest unit of indicated delivery and recorded delivery, if the device is equipped to record, shall not exceed the equivalent of:

(a) 50 L (10 gal) on utility type meters,

(b) 0.2 L (1/10 gal) on batching meters delivering less than 375 L/min (100 gal/min), or

(c) 5 L (1 gal) on batching meters delivering 375 L/min (100 gal/min) or more.

S.1.1.4. Advancement of Indicating and Recording Elements. Primary indicating and recording elements shall be susceptible to advancement only by the mechanical operation of the device.

S.1.1.5. Return to Zero. If the meter is so designed that the primary indicating elements are readily returnable to a definite zero indication, means shall be provided to prevent the return of these elements beyond their correct zero position.

S.1.2. Graduations.

S.1.2.1. Length. - Graduations shall be so varied in length that they may be conveniently read.

S.1.2.2. Width. - In any series of graduations, the width of a graduation shall in no case be greater than the width of the minimum clear interval between graduations, and the width of main graduations shall be not more than 50 percent greater than the width of subordinate graduations. Graduations shall in no case be less than 0.2 mm (0.008 in) in width.

S.1.2.3. Clear Interval Between Graduations. The clear interval shall not be less than 1.0 mm (0.04 in). If the graduations are not parallel, the measurement shall be made:

(a) along the line of relative movement between the graduations at the end of the indicator, or

(b) if the indicator is continuous, at the point of widest separation of the graduations.

S.1.3. Indicators.

S.1.3.1. Symmetry. The index of an indicator shall be symmetrical with respect to the graduations, at least throughout that portion of its length associated with the graduations.

S.1.3.2. Length. The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case the distance between the end of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 1.0 mm (0.04 in).

S.1.3.3. Width. The width of the index of an indicator in relation to the series of graduations with which it is used shall not be greater than:

(a) *the width of the narrowest graduation*,* and *[*Nonretroactive as of January 1, 2002]* (Amended 2001)

(b) the width of the minimum clear interval between graduations.

When the index of an indicator extends along the entire length of a graduation, that portion of the index of the indicator that may be brought into coincidence with the graduation shall be of the same width throughout the length of the index that coincides with the graduation.

S.1.3.4. Clearance. The clearance between the index of an indicator and the graduations shall in no case be more than 1.5 mm (0.06 in).

S.1.3.5. Parallax. Parallax effects shall be reduced to the practicable minimum.

S.2. Design of Measuring Elements.

S.2.1. Provision for Sealing. - Adequate provision shall be made for applying security seals in such a manner that no adjustment may be made of:

(a) any measurement elements, and

(b) any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries.

The adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

S.2.2. Batching Meters Only.

S.2.2.1. Air Elimination. Batching meters shall be equipped with an effective air eliminator.

S.2.2.2. Directional Flow Valves. Valves intended to prevent reversal of flow shall be automatic in operation.

N. Notes

N.1. Test Liquid. A meter shall be tested with water.

N.2. Evaporation and Volume Change. Care shall be exercised to reduce to a minimum, evaporation losses and volume changes resulting from changes to temperature of the test liquid.

N.3. Test Drafts. Test drafts should be equal to at least the amount delivered by the device in two minutes and in no case less than the amount delivered by the device in one minute at the actual maximum flow rate developed by the installation. The test drafts shown in Table 1, next page, shall be followed as closely as possible.

N.4. Testing Procedures.

N.4.1. Normal Tests. The normal test of a meter shall be made at the maximum discharge rate developed by the installation. Meters with maximum gallon per minute ratings higher than Table 1 values may be tested up to the meter rating, with meter indications no less than those shown.
(Amended 1990 and 2002)

N.4.1.1. Repeatability Tests. – Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors, such as temperature, pressure, and flow rate are reduced to the extent that they will not affect the results obtained.
(Added 2002)

N.4.2. Special Tests. Special tests to develop the operating characteristics of meters may be made according to the rates and quantities shown in Table 2.

N.4.3. Batching Meter Tests. Tests on batching meters should be conducted at the maximum and intermediate rates only.

T. Tolerances

T.1. Tolerance Values. - Maintenance and acceptance tolerances shall be as shown in Table 1 and Table 2.

T.1.1. Repeatability. – When multiple tests are conducted at approximately the same flow rate, the range of the test results shall not exceed 0.6 percent for tests performed at the normal and intermediate flow rates, and 1.3 percent for tests performed at the minimum flow rate, and each test shall be within the applicable tolerance.
(Added 2002)

Table 1. Tolerances for Water Meters
Normal Tests

Meter size (inches)	Rate of flow (gal/min)	Maximum Rate		
		Meter indication		Tolerance on over- and under-registration
		Gal	ft^3	
Less than 5/8	8	50	5	
5/8	15	50	5	
3/4	25	50	5	
1	40	100	10	
1 1/2	80	300	40	1.5%
2	120	500	40	
3	250	500	50	
4	350	1 000	100	
6	700	1 000	100	

(Amended 2002)

Table 2. Tolerances for Water Meters
Special Tests

Meter size (inches)	Intermediate rate				Minimum rate				
	Rate of flow (gal/min)	Meter indication		Tolerance on over- and under-registration	Rate of flow (gal/min)	Meter indication		Tolerance	
		gal	ft^3			gal	ft^3	Under-registration	Over-registration
Less than or equal to 5/8	2	10	1		1/4	5	1		
3/4	3	10	1		1/2	5	1		
1	4	10	1		3/4	5	1		
1 1/2	8	50	5	1.5%	1 1/2	10	1	5.0%	1.5%
2	15	50	5		2	10	1		
3	20	50	5		4	10	1		
4	40	100	10		7	50	5		
6	60	100	10		12	50	5		

(Amended 2002)

UR. User Requirements

UR.1. Batching Meters Only.

UR.1.1. Strainer. A filter or strainer shall be provided if it is determined that the water contains excessive amounts of foreign material.

UR.1.2. Siphon Breaker. An automatic siphon breaker or other effective means shall be installed in the discharge piping at the highest point of outlet, in no case below the top of the meter, to prevent siphoning of the meter and permit rapid drainage of the pipe or hose.

UR.1.3. Provision for Testing. Acceptable provisions for testing shall be incorporated into all meter systems. Such provisions shall include a two-way valve, or manifold valving, and a pipe or hose installed in the discharge line accessible to the proper positioning of the test measure.

S.4. Discharge Lines and Valves.

S.4.1. Diversion of Measured Product. - No means shall be provided by which any measured product can be diverted from the measuring instrument. However, two or more delivery outlets may be permanently installed and operated simultaneously, provided that any diversion of flow to other than the intended receiving receptacle cannot be readily accomplished or is readily apparent. Such means include physical barriers, visible valves or indications that make it clear which outlets are in operation, and explanatory signs if deemed necessary.

A manually controlled outlet that may be opened for purging or draining the measuring system, or for recirculating product if recirculation is required in order to maintain the product in a deliverable state shall be permitted. Effective means shall be provided to prevent the passage of liquid through any such outlet during normal operation of the measuring system and to inhibit meter indications (or advancement of indications) and recorded representations while the outlet is in operation. (Amended 2002)

S.4.2. Pump-Discharge Unit. - A pump-discharge unit for liquids equipped with a flexible discharge hose shall be of the wet-hose type.
(Added 1993)

S.4.3. Directional Flow Valves. - If a reversal of flow could result in errors that exceed the tolerance for the minimum measured quantity, a valve or valves or other effective means, automatic in operation (and equipped with a pressure limiting device, if necessary) to prevent the reversal of flow shall be properly installed in the system. (See N.1.)

S.4.4. Discharge Valves. - A discharge valve may be installed on a discharge line only if the system is a wet-hose type. Any other shut-off valve on the discharge side of the instrument shall be of the automatic or semiautomatic predetermined-stop type or shall be operable only:

- by means of a tool (but not a pin) entirely separate from the device, or
- by means of a security seal with which the valve is sealed open.

S.4.5. Antidrain Means. - In a wet-hose type device, effective means shall be provided to prevent the drainage of the hose between transactions.

S.4.6. Other Valves. - Check valves and closing mechanisms that are not used to define the measured quantity shall have relief valves (if necessary) to dissipate any abnormally high pressure that may arise in the measuring assembly.

S.5. Markings. - A measuring system shall be legibly and indelibly marked with the following information:

(a) pattern approval mark (i.e., type approval number);

(b) name and address of the manufacturer or his trademark and, if required by the weights and measures authority, the manufacturer's identification mark in addition to the trademark;

(c) model designation or product name selected by the manufacturer;

(d) nonrepetitive serial number;

*(e) the accuracy class of the meter as specified by the manufacturer consistent with Table T.2.;**
(Added 1994)

(f) maximum and minimum flow rates in pounds per unit of time;

(g) maximum working pressure;

(h) applicable range of temperature if other than -10 °C to +50 °C;

(i) minimum measured quantity; and

(j) product limitations, if applicable.

*[*Nonretroactive as of January 1, 1995.]*

S.5.1. Marking of Gasoline Volume Equivalent Conversion Factor. - A device dispensing com-pressed natural gas shall have either the statement "1 Gasoline Liter Equivalent (GLE) is Equal to 0.678 kg of Natural Gas" or "1 Gasoline Gallon Equivalent (GGE) is Equal to 5.660 lb of Natural Gas" permanently and conspicuously marked on the face of the dispenser according to the method of sale used.
(Added 1994)

S.6. Printer. - When an assembly is equipped with means for printing the measured quantity, the following conditions apply:

(a) the scale interval shall be the same as that of the indicator;

(b) the value of the printed quantity shall be the same value as the indicated quantity;

(c) a quantity for a delivery (other than an initial reference value) cannot be recorded until the measurement and delivery has been completed;

(d) the printer is returned to zero when the resettable indicator is returned to zero; and

(e) the printed values shall meet the requirements applicable to the indicated values.

S.6.1. Printed Receipt. - Any delivered, printed quantity shall include an identification number, the time and date, and the name of the seller. This information may be printed by the device or preprinted on the ticket.

S.7. Totalizers for Retail Motor-Fuel Devices. *- Retail motor-fuel dispensers shall be equipped with a nonresettable totalizer for the quantity delivered through the metering device. [Nonretroactive as of January 1, 1998]*
(Added 1997)

N. Notes

N.1. Minimum Measured Quantity. - The minimum measured quantity shall be specified by the manufacturer.

N.2. Test Medium.

N.2.1. Liquid-Measuring Devices. - The device shall be tested with the liquid that the device is intended to measure or another liquid with the same general physical characteristics.

N.2.2. Vapor-Measuring Devices. - The device shall be tested with air or the product to be measured.

N.3. Test Drafts. - The minimum test shall be one test draft at the maximum flow rate of the installation and one test draft at the minimum flow rate. More tests may be performed at these or other flow rates. (See T.3.)

N.4. Minimum Measured Quantity. - The device shall be tested for a delivery equal to the declared minimum measured quantity when the device is likely to be used to make deliveries on the order of the minimum measured quantity.

N.5. Motor Fuel Dispenser. - When a device is intended for use as a liquid motor-fuel dispenser, the type evaluation test shall include a test for accuracy using 5 starts and stops during a delivery to simulate the operation of the automatic shut-off nozzle. This test may be conducted as part of the normal inspection and test of the meter.

N.6. Testing Procedures.

N.6.1. Normal Tests. – The normal test of a meter shall be made at the maximum discharge rate developed by the installation. Any additional tests conducted at flow rates down to and including the rated minimum discharge flow rate shall be considered normal tests.
(Added 1999)

N.6.1.1. Repeatability Tests. - Tests for repeatability should include a minimum of three consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors, such as, temperature pressure and flow rate are reduced to the extent that they will not affect the results obtained.
(Added 2001)

N.6.2. Special Tests. – Special tests to develop the operating characteristics of a meter and any special elements and accessories attached to or associated with the device, shall be made as circumstances require. Any test except as set forth in N.6.1. shall be considered a special test. Special test of a mea-suring system shall be made to develop operating characteristics of the measuring systems during a split compartment delivery. (See Table T.2.)
(Added 1999)

T. Tolerances

T.1. Tolerances, General

(a) The tolerances apply equally to errors of underregistration and errors of overregistration.

(b) The tolerances apply to all products at all temperatures measured at any flow rate within the rated measuring range of the meter.
(Amended 1999)

T.2. Tolerances. - The tolerances for mass flow meters for specific liquids, gases, and applications are listed in Table T.2.
(Amended 1994 and 1999)

T.3. Repeatability. - When multiple tests are conducted at approximately the same flow rate and draft size, the range of the test results for the flow rate shall not exceed 40 percent of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance. See also N.6.1.1.
(Amended 1992, 1994 and 2001)

T.4. Type Evaluation Examinations for Liquid-Measuring Devices. - For type evaluation examinations, the tolerance values shall apply under the following conditions:

(a) with any one liquid within the range of liquids,

(b) at any one liquid temperature and pressure within the operating range of the meter, and

(c) at all flow rates within the range of flow rates.
(Added 1993) (Amended 1994)

UR.3.5. Accessory Devices. - Accessory devices, if necessary in the determination of a moisture content value, shall be in close proximity to the moisture meter and allow immediate use.

UR.3.6. Sampling. - A grain sample shall be obtained by following appropriate sampling methods and equipment. These include, but are not limited to grain probes of appropriate length used at random locations in the bulk, the use of a pelican sampler, or other techniques and equipment giving equivalent results. The grain sample shall be taken such that it is representative of the lot.

UR.3.7. Location. - See G-UR.3.3.

UR.3.8. Level Condition. - If equipped with a level indicator, a meter shall be maintained in a level condition. (Added 1988)

UR.3.9. Current Calibration Data. - Grain moisture determinations shall be made using only the most recently published calibration data.

UR.3.10. Posting of Meter Operating Range. - The operating range of the grain moisture meter shall be clearly and conspicuously posted in the place of business such that the information is readily visible from a reasonable customer position. The posted information shall include the following:

(a) The temperature range over which the meter may be used and still comply with the applicable requirements. If the temperature range varies for different grains or seed, the range shall be specified for each.

(b) The moisture range for each grain or seed for which the meter is to be used.

(c) The temperature range for each grain or seed for which the meter is to be used.

(d) The maximum allowable difference in temperature that may exist between the meter and the sample for which an accurate moisture determination can be made.
(Added 1988)

Table S.1.2. Grain Types Considered for Type Evaluation and Calibration and Minimum Acceptable Abbreviations

Grain Type	***Minimum Acceptable Abbreviation***	***Grain Type***	***Minimum Acceptable Abbreviation***
Corn	*CORN*	*Soybeans*	*SOYB*
Durum Wheat *Soft White Wheat* *Hard Red Spring Wheat* *Hard Red Winter Wheat* *Soft Red Winter Wheat* *Hard White Wheat*	*DURW* *SWW* *HRSW* *HRWW* *SRWW* *HDWW*	*Two-rowed Barley* *Six-rowed Barley* *Oats*	*TRB* *SRB* *OATS*
Sunflower Seed (Oil)	*SUNF*	*Long Grain Rough Rice* *Medium Grain Rough Rice*	*LGRR* *MGRR*
Grain Sorghum	*SORG or MILO*	*Small Oil Seeds (under consideration)*	

[Nonretroactive as of January 1, 1998] (Table Added 1993) (Amended 1995, 1998)

Table S.2.5. Categories of Device and Methods of Sealing

Categories of Device	*Method of Sealing*
Category 1: No remote configuration capability.	*Seal by physical seal or two event counters: One for calibration parameters (000 to 999) and one for configuration parameters (000 to 999). If equipped with event counters, the device must be capable of displaying, or printing through the device or through another on-site device, the contents of the counters.*
Category 2: Remote configuration capability, but access is controlled by physical hardware. *A device shall clearly indicate that it is in the remote configuration mode and shall not be capable of operating in the measure mode while enabled for remote configuration.*	*The hardware enabling access for remote communication must be at the device and sealed using a physical seal or two event counters; one for calibration parameters (000 to 999) and one for configuration parameters (000 to 999). If equipped with event counters, the device must be capable of displaying, or printing through the device or through another on-site device, the contents of the counters.*
Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password). *When accessed remotely for the purpose of modifying sealable parameters, the device shall clearly indicate that it is in the configuration mode and shall not be capable of operating in the measuring mode.*	*An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter (for calibration changes consisting of multiple constants, the calibration version number may be used rather than the calibration constants). A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to twenty-five (25) times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)*
Category 3a: No remote capability, but operator is able to make changes that affect the metrological integrity of the device (e.g., slope, bias, etc.) in normal operation.	*Same as Category 3.*
Category 3b: No remote capability, but access to metrological parameters is controlled through a software switch (e.g., password).	*Same as Category 3.*

[Table Nonretroactive as of January 1, 1999.] (Amended 1998)

S.1.11. Provision for Sealing.

(a) A device shall be designed with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that detrimentally affects the metrological integrity of the device can be made to any measuring element.

(b) Audit trails shall use the format set forth in Table S.1.11.

S.2. Design of Zero and Tare.

S.2.1. Zero or Ready Adjustment. A device shall be equipped with means by which the zero reference or ready condition can be adjusted, or the zero reference or ready condition shall be automatically maintained. The zero reference or ready control circuits shall be interlocked so that their use is prohibited during measurement operations.

S.2.2. Tare. The tare function shall operate only in a backward direction (that is, in a direction of under-registration) with respect to the zero reference or ready condition of the device. The value of the tare division or increment shall be equal to the division of its respective axis on the device. There shall be a clear indication that tare has been taken.

S.3. Systems with Two or More Measuring Elements. A multiple dimension measuring system with a single indicating or recording element, or a combination indicating-recording element, that is coupled to two or more measuring elements with independent measuring systems, shall be provided with means to prohibit the activation of any measuring element (or elements) not in use, and shall be provided with automatic means to indicate clearly and definitely which measuring element is in use.

S.4. Marking Requirements. [See also G-S.1., G-S.4., G-S.5.2.5., G-S.6., G-S.7., G-UR.2.1.1., and G-UR.3.1.]

S.4.1. Multiple Dimension Measuring Devices, Main Elements, and Components of Measuring Devices. Multiple dimension measuring devices, main elements of multiple dimension measuring devices when not contained in a single enclosure for the entire dimension/volume measuring device, and other components shall be marked as specified in Table S.4.1.a. and explained in the accompanying notes, Table S.4.1.b.

S.4.2. Location Of Marking Information. The required marking information shall be so located that it is readily observable without the necessity of the disassembly of a part requiring the use of any means separate from the device.

Table S.1.11. Categories of Devices and Methods of Sealing

Categories of Devices	Method of Sealing
Category 1: No remote configuration.	Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.
Category 2: Remote configuration capability, but access is controlled by physical hardware. Device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode.	The hardware enabling access for remote communication must be at the device and sealed using a physical seal or two event counters: one for calibration parameters and one for configuration parameters.
Category 3. Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).	An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to ten times the number of sealable parameters in the device, but not more than 1000 records are required. **(Note: Does not require 1000 changes to be stored for each parameter.)**

5.58. Multiple Dimension Measuring Devices

Table S.4.1.a. Marking Requirements for Multiple Dimension Measuring Systems				
	Multiple Dimension Measuring Equipment			
To be Marked With	Multiple dimension measuring device and indicating element in same housing	Indicating element not permanently attached to multiple dimension measuring element	Multiple dimension measuring element not permanently attached to the indicating element	Other equipment (1)
Manufacturer's ID	X	X	X	X
Model Designation	X	X	X	X
Serial Number and Prefix	X	X	X	X (2)
Certificate of Conformance Number (8)	X	X	X	X (8)
Minimum and Maximum Dimensions for Each Side (3)	X	X	X	
Value of Measuring Division, d	X	X	X	
Temperature Limits (4)	X	X	X	
Minimum & Maximum Speed (5)	X	X	X	
Special Application (6)	X	X	X	
Limitation of Use (7)	X	X	X	

(Amended 2002)

Multiple Dimension Measuring Systems Table S.4.1.b.
Notes for Table S.4.1.a.

1. Necessary to the dimension and/or volume measuring system, but having no effect on the measuring value (e.g. auxiliary remote display, keyboard, etc.).

2. Modules without "intelligence" on a modular system (e.g., printer, keyboard module, etc.) are not required to have serial numbers.

3. The minimum and maximum dimensions can be shown as follows:

   Length: min._____ max.
   Width : min._____ max.
   Height: min._____ max.

4. Required if the range is other than -10 to 40 °C (14 to 104 °F).

5. If the multiple dimension measuring device requires that the object or device be moved relative to one another, the minimum and maximum speeds are marked which enable the device to make measurements that are within the applicable tolerances shall be marked.

6. A device designed for a special application rather than general use shall be conspicuously marked with suitable words visible to the operator and the customer restricting its use to that application.

7. Materials, shapes, structures, or object orientations that are inappropriate for the device or those that are appropriate.
8. Required only if a Certificate of Conformance has been issued for the equipment.

(Amended 2002)

N. Notes

N.1. Test Procedures.

N.1.1. General. The device shall be tested using test standards and objects of known and stable dimensions.

N.1.2. Position Test. Measurements are made using different positions of the test object and consistent with the manufacturer's specified use for the device.

N.1.3. Disturbance Tests, Field Evaluation. A disturbance test shall be conducted at a given installation when the presence of disturbances specified in T.6. has been verified and characterized if those conditions are considered "usual and customary."
(Amended 2002)

N.1.4. Test Object Size. Test objects may vary in size from the smallest dimension to the largest dimension marked on the device, and for field verification examinations, shall be an integer multiple of "d."

N.1.5. Digital Zero Stability. A zero indication change test shall be conducted on all devices which show a digital zero. After the removal of any test object, the zero indication shall not change. (Also see G-UR.4.2.)

T. Tolerances

T.1. Design. The tolerance for a multiple dimension measuring device is a performance requirement independent of the design principle used.

T.2. Tolerance Application.

T.2.1. Type Evaluation. For type evaluations, the tolerance values apply to tests within the influence factor limits of temperature and power supply voltage specified in T.5.1. and T.5.2.

T.2.2. Subsequent Verification. For subsequent verifications, the tolerance values apply regardless of the influence factors in effect at the time of the verification. (Also see G-N.2.)

T.2.3. Multi-interval (Variable Division-Value) Devices. For multi-interval devices, the tolerance values are based on the value of the device division of the range in use.

T.3. Tolerance Values. The maintenance and acceptance tolerance values shall be ± 1 d. These tolerances apply regardless of the shape or material of the object being measured unless otherwise marked on the device.

T.4. Position Tests. For a test standard measured several times in different positions by the device all indications shall be within applicable tolerances.

T.5. Influence Factors. The following factors are applicable to tests conducted under controlled conditions only.

T.5.1. Temperature. Devices shall satisfy the tolerance requirements under the following temperature conditions.

T.5.1.1. Temperature Limits. If not marked on the device, the temperature limits shall be:

-10 °C to 40 °C (14 °F to 104 °F).

T.5.1.2. Minimum Temperature Range. If temperature limits are specified for the device, the range shall be at least 30 °C or 54 °F.

T.5.1.3. Temperature Effect on Zero Indication. The zero indication shall not vary by more than one division per 5 °C (9 °F) change in temperature.

T.5.2. Power Supply Voltage. Devices shall satisfy the applicable tolerances when subjected to power supply voltage variation of -15 percent to +10 percent of the voltage rating specified by the manufacturer.

T.6. Disturbances, Field Evaluation. The following requirements apply to devices when subjected to disturbances which may normally exist in the surrounding environment. These disturbances include radio frequency interference (RFI), electromagnetic interference (EMI), acoustic changes, ambient light emissions, etc. The difference between the measurement indication with the disturbance and the measurement indication without the disturbance shall not exceed one division "d" or the equipment shall:

(a) blank the indication, or

(b) provide an error message, or

(c) the indication shall be so completely unstable that it could not be interpreted, or transmitted into memory or to a recording element, as a correct measurement value.

T.7. Electric Power Supply. – Battery-operated instruments shall not indicate nor record values outside the applicable tolerance limits when battery power output is excessive or deficient.
(Added 1999)

UR. User Requirements

UR.1. Selection Requirements. Equipment shall be suitable for the service in which it is used with respect to elements of its design, including but not limited to, its maximum capacity, value of the division, minimum capacity, and computing capability.

UR.1.1. Value of the Indicated and Recorded Division. The value of the division recorded shall be the same as the division value indicated.

UR.2. Installation Requirements.

UR.2.1. Supports. A device that is portable and is being used on a counter, table, or the floor shall be so positioned that it is firmly and securely supported.

UR.2.2. Foundation, Supports, and Clearance. The foundations and support of a device installed in a fixed location shall be such as to provide strength, rigidity, and permanence of all components, and clearance shall be provided around all live parts to the extent that no contacts may result when the measuring element is empty, nor throughout the performance range of the device such that the operation or performance of the device is adversely affected.

UR.2.3. Protection From Environmental Factors. The indicating and measuring elements of a device shall be adequately protected from environmental factors such as wind, weather, and RFI that may adversely affect the operation or performance of the device.

UR.3. Use Requirements.

UR.3.1. Minimum and Maximum Measuring Ranges. A device shall not be used to measure objects smaller than the minimum or larger than the maximum dimensions marked on the device.

UR.3.2. Special Designs. A multiple dimension measuring device designed and marked for a special application shall not be used for other than its intended purpose.

UR.4. Maintenance Requirements.

UR.4.1. Zero or Ready Condition. The zero-setting adjustment of a multiple dimension measuring device shall be maintained so that, with no object in or on the measuring element, the device shall indicate or record a zero or ready condition.

UR.4.2. Level Condition. If a multiple dimension measuring device is equipped with a level-condition indicator, the device shall be maintained in a level condition.

UR.4.3. Device Modification. The measuring capabilities of a device shall not be changed from the manufacturer's design unless the modification has been approved by the manufacturer and the weights and measures authority having jurisdiction over the device.

Definitions

billed weight. The weight used in the computation of the freight, postal, or storage charge, whether actual weight or dimensional weight.

"d", dimension division value. The smallest increment that the device displays for any axis and length of object in that axis.

dimensional weight (or dim. weight). A value computed by dividing the object's volume by a conversion factor; it may be used for the calculation of charges when the value is greater than the actual weight.

measuring element. That portion of a complete device which does not include the indicating element.

Definitions

The specific code to which the definition applies is shown in [brackets] at the end of the definition. Definitions for the General Code [1.10] apply to all codes in Handbook 44.

A

absolute value. The absolute value of a number is the magnitude of that number without considering the positive or negative sign. [2.20]

acceptance test. The first official test of a farm milk tank, at a particular location, in which the tank is accepted as correct. This test applies to newly constructed tanks, relocated used tanks, and recalibrated tanks. [4.43]

accurate. A piece of equipment is "accurate" when its performance or value-that is, its indications, its deliveries, its recorded representations, or its capacity or actual value, etc., as determined by tests made with suitable standards-conforms to the standard within the applicable tolerances and other performance requirements. Equipment that fails so to conform is "inaccurate." (Also see "correct.") [1.10]

analog type. A system of indication or recording in which values are presented as a series of graduations in combination with an indicator, or in which the most sensitive element of an indicating system moves continuously during the operation of the device. [1.10]

animal scale. A scale designed for weighing single heads of livestock. [2.20]
(Amended 1987)

apparent mass versus 8.0 g/cm^3. The apparent mass of an object versus 8.0 g/cm^3 is the mass of material of density 8.0 g/cm^3 that produces exactly the same balance reading as the object when the comparison is made in air with a density of 1.2 mg/cm^3 at 20 °C. [3.30, 3.32]

approval seal. A label, tag, stamped or etched impression, or the like, indicating official approval of a device. (Also see "security seal.") [1.10]

atmospheric pressure. The average atmospheric pressure agreed to exist at the meter at various ranges of elevation, irrespective of variations in atmospheric pressure from time to time. [3.33]

audit trail. An electronic count and/or information record of the changes to the values of the calibration or configuration parameters of a device. [1.10, 2.20, 3.30]
(Added 1993)

automatic bulk weighing system. A weighing system adapted to the automatic weighing of bulk commodities in successive drafts of predetermined amounts, automatically recording the no-load and loaded weight values and accumulating the net weight of each draft. [2.22]

automatic hopper scale. One adapted to the automatic weighing of bulk commodity in successive drafts of pre-determined amounts. (This is not an "automatic-indicating scale" defined below.) [2.20]

automatic-indicating scale. One on which the weights of applied loads of various magnitudes are automatically indicated throughout all or a portion of the weighing range of the scale. (A scale that automatically weighs out commodity in pre-determined drafts, such as an automatic hopper scale, a packaging scale, and the like, is not an "automatic-indicating" scale.) [2.20]

automatic temperature or density compensation. The use of integrated or ancillary equipment to obtain from the output of a volumetric meter an equivalent mass, or an equivalent liquid volume at a normal temperature of 70 °F and absolute pressure of 14.696 lb/in^2 absolute. [3.34]

automatic zero-setting mechanism. Automatic means provided to maintain zero balance indication without the intervention of an operator. [2.20]

automatic zero-setting mechanism (belt-conveyor scale). A zero setting device that operates automatically without intervention of the operator after the belt has been running empty. [2.21]
(Added 2002)

auxiliary indicator. Any indicator other than the master weight totalizer that indicates the weight of material determined by the scale. [2.21]

axle-load scale. A scale permanently installed in a fixed location, having a load-receiving element specially adapted to determine the combined load of all wheels (1) on a single axle or (2) on a tandem axle of a highway vehicle. [2.20]

B

badge. A metal plate affixed to the meter by the manufacturer showing the manufacturer's name, serial number and model number of the meter, and its rated capacity. [3.33]

balance, zero-load. See "zero-load balance." [2.20]

balance indicator. A combination of elements, one or both of which will oscillate with respect to the other, for indicating the balance condition of a nonautomatic indicating scale. The combination may consist of two indicating edges, lines, or points, or a single edge, line, or point and a graduated scale. [2.20]

balancing mechanism. A mechanism (including a balance ball) that is designed for adjusting a scale to an accurate zero-load balance condition. [2.20]

base pressure. The absolute pressure used in defining the gas measurement unit to be used, and is the gauge pressure at the meter plus an agreed atmospheric pressure. [3.33]

basic time rate. The charge for time for all intervals except the initial interval. [5.54]

basic tolerances. Basic tolerances are those tolerances on underregistration and on overregistration, or in excess and in deficiency, that are established by a particular code for a particular device under all normal tests, whether maintenance or acceptance. Basic tolerances include minimum tolerance values when these are specified. Special tolerances, identified as such and pertaining to special tests, are not basic tolerances. [1.10]

basic distance rate. The charge for distance for all intervals except the initial interval. [5.54]

batching meter. A device used for the purpose of measuring quantities of water to be used in a batching operation. [3.36]

beam scale. One on which the weights of loads of various magnitudes are indicated solely by means of one or more weigh-beam bars either alone or in combination with counterpoise weights. [2.20]

beam. See "weighbeam." [2.20]

bell prover. A calibrated cylindrical metal tank of the annular type with a scale thereon that, in the downward travel in a surrounding tank containing a sealing medium, displaces air through the meter being proved or calibrated. [3.33]

belt-conveyor. An endless moving belt for transporting material from place to place. [2.21]

belt-conveyor scale. A device that employs a weighing element in contact with a belt to sense the weight of the material being conveyed and the speed (travel) of the material, and integrates these values to produce total delivered weight. [2.21]

belt-conveyor scale systems area. The scale area refers to the scale suspension, weigh idlers attached to the scale suspension, 5 approach (-) idlers, and 5 retreat (+) idlers. [2.21]
(Added 2001)

bench scale. See "counter scale." [2.20]

binary submultiples. Fractional parts obtained by successively dividing by the number 2. Thus, one-half, one fourth, one-eighth, one-sixteenth, and so on, are binary submultiples. [1.10]

C

calibration parameter. Any adjustable parameter that can affect measurement or performance accuracy and, due to its nature, needs to be updated on an ongoing basis to maintain device accuracy, e.g., span adjustments, linearization factors, and coarse zero adjustments. [2.20, 3.30]
(Added 1993)

car-wash timer. A timer used in conjunction with a coin-operated device to measure the time during which car-wash water, cleaning solutions, or waxing solutions are dispensed. [5.55]

center-reading tank. One so designed that the gauge rod or surface gauge, when properly positioned for use, will be approximately in the vertical axis of the tank, centrally positioned with respect to the tank walls. [4.43]

cereal grain and oil seeds. Agricultural commodities including, but not limited to, corn, wheat, oats, barley, flax, rice, sorghum, soybeans, peanuts, dry beans, safflower, sunflower, fescue seed, etc. [5.56]

chart recorder. See analog or digital recorder.
(Amended 2002)

check rate. A rate of flow usually 20 percent of the capacity rate. [3.33]

checkweighing scale. One used to verify predetermined weight within prescribed limits. [2.20]

class of grain. Hard Red Winter Wheat as distinguished from Hard Red Spring Wheat as distinguished from Soft Red Winter Wheat, etc. [5.56]

clear interval between graduations. The distance between adjacent edges of successive graduations in a series of graduations. If the graduations are "staggered," the interval shall be measured, if necessary, between a graduation and an extension of the adjacent graduation. (Also see "minimum clear interval.") [1.10]

cleared. A taximeter is "cleared" when it is inoperative with respect to all fare indication, when no indication of fare or extras is shown and when all parts are in those positions in which they are designed to be when the vehicle on which the taximeter is installed is not engaged by a passenger. [5.54]

cold-tire pressure. The pressure in a tire at ambient temperature. [5.53, 5.54]

computing type or computing type device. A device designed to indicate, in addition to weight or measure, the total money value of product weighed or measured, for one of a series of unit prices. [1.10]

computing scale. One that indicates the money values of amounts of commodity weighed, at predetermined unit prices, throughout all or part of the weighing range of the scale. [2.20]

concave curve. A change in the angle of inclination of a belt conveyor where the center of the curve is above the conveyor. [2.21]

concentrated load capacity (CLC). A capacity rating of a vehicle, axle-load, or livestock scale, specified by the manufacturer, defining the maximum load concentration for which the weighbridge is designed. In the case of vehicle and axle-load scales, it is the maximum axle-load concentration (for a group of two axles with a centerline spaced 4 feet apart and an axle width of 8 feet) for which the weighbridge is designed as specified by the manufacturer. The concentrated load capacity rating is for both test and use. [2.20]
(Added 1988) (Amended 1991, 1994)

configuration parameter. Any adjustable or selectable parameter for a device feature that can affect the accuracy of a transaction or can significantly increase the potential for fraudulent use of the device and, due to its nature, needs to be updated only during device installation or upon replacement of a component, e.g., division value (increment), sensor range, and units of measurement. [2.20, 3.30]
(Added 1993)

consecutive-car test train. A train consisting of cars weighed on a reference scale, then coupled consecutively and run over the coupled-in-motion railway track scale under test. [2.20]
(Added 1990)

construction-material hopper scale. A scale adapted to weighing construction materials such as sand, gravel, cement, and hot oil. [2.20]

contract sale. A sale where a written agreement exists, prior to the point of sale, in which both buyer and seller have accepted pricing conditions of the sale. Examples include, but are not limited to: e-commerce, club sales, or pre-purchase agreements. Any devices used in the determination of quantity must comply with NIST Handbook 44. [3.30, 3.31, 3.37]
(Added 1993) (Amended 2002)

conventional scale. If the use of conversion tables is necessary to obtain a moisture content value, the moisture meter indicating scale is called "conventional scale." The values indicated by the scale are dimensionless. [5.56]

conversion table. Any table, graph, slide rule, or other external device used to determine the moisture content from the value indicated by the moisture meter. [5.56]

correction table. Any table, graph, slide rule, or other external device used to determine the moisture content from the value indicated by the moisture meter when the indicated value is altered by a parameter not automatically corrected for in the moisture meter (for example, temperature or test weight). [5.56]

convex curve. A change in the angle of inclination of a belt conveyor where the center of the curve is below the conveyor. [2.21]

conveyor stringers. Support members for the conveyor on which the scale and idlers are mounted. [2.21]

correct. A piece of equipment is "correct" when, in addition to being accurate, it meets all applicable specification requirements. Equipment that fails to meet any of the requirements for correct equipment is "incorrect." (Also see "accurate.") [1.10]

counter scale. One that, by reason of its size, arrangement of parts, and moderate nominal capacity, is adapted for use on a counter or bench. Sometimes called "bench scale." [2.20]

counterbalance weight. One intended for application near the butt of a weighbeam for zero-load balancing purposes. [2.20]

counterpoise weight. A slotted or "hanger" weight intended for application near the tip of the weighbeam of a scale having a multiple greater than 1. [2.20]

coupled-in-motion railroad weighing system. A device and related installation characteristics consisting of (1) the associated approach trackage, (2) the scale (i.e., the weighing element, the load-receiving element, and the indicating element with its software), and (3) the exit trackage which permit the weighing of railroad cars coupled in motion. [2.20]
(Added 1992)

crane scale. One with a nominal capacity of 5000 pounds or more designed to weigh loads while they are suspended freely from an overhead, trackmounted crane. [2.20]

cryogenic liquid-measuring device. A system including a mechanism or machine of (a) the meter or mass flow type, or (b) a weighing type of device mounted on a vehicle, designed to measure and deliver cryogenic liquids in the liquid state. Means may be provided to indicate automatically, for one of a series of unit prices, the total money value of the liquid measured. [3.34] (Amended 1986)

cryogenic liquids. Fluids whose normal boiling point is below 120 kelvin (-243 °F). [3.34]

cubic foot, standard. That quantity of gas that occupies a volume of one cubic foot when under a pressure of 14.73 lb/in^2 absolute and at a temperature of 60 °F. [3.33]

cubic foot, metered. That quantity of gas that occupies one cubic foot when under pressure and temperature conditions existing in the meter. [3.33]

cubic-foot bottle. A metal bottle open at the lower end and so supported that it may be easily raised or lowered in a tank that contains a sealing medium. With the level of the sealing medium properly adjusted, the bottle, when lowered, will displace exactly one cubic foot of air upon coming to rest on the bottom of the tank. The marks on the bottle defining the cubic foot are the bottom of the lower neck and the gauge mark that partially surrounds the gauge glass in the upper neck. [3.33]

cubic foot, gas. The amount of a cryogenic liquid in the gaseous state at a temperature of 70 °F and under a pressure of 14.696 lb/in^2 absolute that occupies one cubic foot. (See NTP.) [3.34]

D

dairy-product-test scale. A scale used in determining the moisture content of butter and/or cheese or in determining the butterfat content of milk, cream, or butter. [2.20]

decreasing-load test. A test for automatic-indicating scales only, wherein the performance of the scale is tested as the load is reduced. [2.20]
(Amended 1987)

deficiency. See "excess and deficiency." [1.10]

digital type. A system of indication or recording of the selector type or one that advances intermittently in which all values are presented digitally, or in numbers. In a digital indicating or recording element, or in digital representation, there are no graduations. [1.10]

direct sale. A sale in which both parties in the transaction are present when the quantity is being determined. An unattended automated or customer-operated weighing or measuring system is considered to represent the device/business owner in transactions involving an unattended device. [1.10]
(Amended 1993)

discharge line. A rigid pipe connected to the outlet of a measuring device. [3.30]
(Added 1987)

discharge hose. A flexible hose connected to the discharge outlet of a measuring device or its discharge line. [3.30]
(Added 1987)

discrimination (of an automatic-indicating scale). The value of the test load on the load-receiving element of the scale that will produce a specified minimum change of the indicated or recorded value on the scale. [2.20]

dispenser. See motor-fuel device. [3.30]

distributed-car test train. A train consisting of cars weighed first on a reference scale, cars coupled consecutively in groups at different locations within the train, then run over the coupled-in-motion railway track scale under test. The groups are typically placed at the front, middle, and rear of the train. [2.20]
(Added 1990)

dry-hose type. A type of device in which it is intended that the discharge hose be completely drained following the mechanical operations involved in each delivery. (See "dry hose.")
[3.30, 3.34]

dry hose. A discharge hose intended to be completely drained at the end of each delivery of product. (See "dry-hose type.") [3.30, 3.31]
(Amended 2002)

dynamic monorail weighing system. A weighing system which employs hardware or software to compensate for dynamic effects from the load or the system that do not exist in a static weighing, in order to provide a stable indication. Dynamic factors may include shock or impact loading, system vibrations, oscillations, etc., and can occur even when the load is not moving across the load receiving element. [2.20]
(Added 1999)

E

e_{min} (minimum verification scale division). The smallest scale division for which a weighing element complies with the applicable requirements. [2.20, 2.21, 2.24]
(Added 1997)

electronic link. An electronic connection between the weighing/load receiving or other sensing element and indicating element where one recognizes the other and neither can be replaced without calibration. [2.20]
(Added 2001)

element. A portion of a weighing or measuring device or system which performs a specific function and can be separated, evaluated separately, and is subject to specified full or partial error limits.
(Added 2002)

equal-arm scale. A scale having only a single lever with equal arms (that is, with a multiple of 1), equipped with two similar or dissimilar load-receiving elements (pan, plate, platter, scoop, or the like), one intended to receive material being weighed and the other intended to receive weights. There may or may not be a weighbeam. [2.20]

event counter. A nonresettable counter that increments once each time the mode that permits changes to sealable parameters is entered and one or more changes are made to sealable calibration or configuration parameters of a device. [2.20, 3.30]
(Added 1993)

event logger. A form of audit trail containing a series of records where each record contains the number from the event counter corresponding to the change to a sealable parameter, the identification of the parameter that was changed, the time and date when the parameter was changed, and the new value of the parameter. [2.20, 3.30]
(Added 1993)

excess and deficiency. When an instrument or device is of such a character that it has a value of its own that can be determined, its error is said to be "in excess" or "in deficiency," depending upon whether its actual value is, respectively, greater or less than its nominal value. (See "nominal.") Examples of instruments having errors "in excess" are: a linear measure that is too long; a liquid measure that is too large; and a weight that is "heavy." Examples of instruments having errors "in deficiency" are: a lubricating-oil bottle that is too small; a vehicle tank compartment that is too small; and a weight that is "light." [1.10]

extras. Charges to be paid by a passenger in addition to the fare, including any charge at a flat rate for the transportation of passengers in excess of a stated number and any charge for the transportation of baggage. [5.54]

F

face. That side of a taximeter on which passenger charges are indicated. [5.54]

face. That portion of a computing-type pump or dispenser which the actual computation of price per unit, delivered quantity, and total sale price. In the case of some electronic displays, this may not be an integral part of the pump or dispenser. [3.30]
(Added 1987)

fare. That portion of the charge for the hire of a vehicle that is automatically calculated by a taximeter through the operation of the distance and/or time mechanism. [5.54]

farm milk tank. A unit for measuring milk or other fluid dairy product, comprising a combination of (1) a stationary or portable tank, whether or not equipped with means for cooling its contents, (2) means for reading the level of liquid in the tank, such as a removable gauge rod or a surface gauge, and (3) a chart for converting level-of-liquid readings to volume; or such a unit in which readings are made on gauge rod or surface gauge directly in terms of volume. Each compartment of a subdivided tank shall, for purposes of this code, be construed to be a "farm milk tank." [4.43]

feeding mechanism. The means for depositing material to be weighed on the belt conveyor. [2.21]

fifth wheel. A commercially-available distance-measuring device which, after calibration, is recommended for use as a field transfer standard for testing the accuracy of taximeters and odometers on rented vehicles. [5.53, 5.54]

fifth-wheel test. A distance test similar to a road test, except that the distance traveled by the vehicle under test is determined by a mechanism known as a "fifth-wheel" that is attached to the vehicle and that independently measures and indicates the distance. [5.53, 5.54]

flag. A plate at the end of the lever arm or similar part by which the operating condition of a taximeter is controlled and indicated. [5.54]

fractional bar. A weighbeam bar of relatively small capacity for obtaining indications intermediate between notches or graduations on a main or tare bar. [2.20]

ft^3/h. Cubic feet per hour. [3.33]

G

gasoline gallon equivalent (GGE). Gasoline gallon equivalent (GGE) means 5.660 pounds of natural gas. [3.37]
(Added 1994)

gasoline liter equivalent (GLE). Gasoline liter equivalent (GLE) means 0.678 kilograms of natural gas. [3.37]
(Added 1994)

gauge pressure. The difference between the pressure at the meter and the atmospheric pressure (psi). [3.33]

gauge rod. A graduated, "dip-stick" type of measuring rod designed to be partially immersed in the liquid and to be read at the point where the liquid surface crosses the rod. [4.43]

gauging. The process of determining and assigning volumetric values to specific graduations on the gauge or gauge rod that serve as the basis for the tank volume chart. [4.43]

graduated interval. The distance from the center of one graduation to the center of the next graduation in a series of graduations. (Also see "value of minimum graduated interval.") [1.10]

graduation. A defining line, or one of the lines defining the subdivisions of a graduated series. The term includes such special forms as raised or indented or scored reference "lines" and special characters such as dots. (Also see "main graduation" and "subordinate graduation.") [1.10]

grain hopper scale. One adapted to the weighing of individual loads of varying amounts of grain. [2.20]

grain moisture meter. Any device indicating either directly or through conversion tables and/or correction tables the moisture content of cereal grains and oil seeds. Also termed "moisture meter." [5.56]

grain sample. That portion of grain or seed taken from a bulk of grain or seed to be bought or sold and used to determine the moisture content of the bulk. [5.56]

grain-test scale. A scale adapted to weighing grain samples used in determining moisture content, dockage, weight per unit volume, etc. [2.20, 5.56]

gravity discharge. A type of device designed for discharge by gravity. [3.30, 3.31
(Amended 2002)]

H

head pulley. The pulley at the discharge end of the belt conveyor. The power drive to drive the belt is generally applied to the head pulley. [2.21]

hired. A taximeter is "hired" when it is operative with respect to all applicable indications of fare or extras. The indications of fare include time and distance where applicable unless qualified by another indication of "Time Not Recording" or an equivalent expression. [5.54]

hopper scale. A scale designed for weighing bulk commodities whose load-receiving element is a tank, box, or hopper mounted on a weighing element. (Also, see "automatic hopper scale," "grain hopper scale," and "construction-material hopper scale.") [2.20]

I

idler space. The center-to-center distance between idler rollers measured parallel to the belt. [2.21]

idlers or idler rollers. Freely turning cylinders mounted on a frame to support the conveyor belt. For a flat belt, the idlers consist of one or more horizontal cylinders transverse to the direction of belt travel. For a troughed belt, the idlers consist of one or more horizontal cylinders and one or more cylinders at an angle to the horizontal to lift the sides of the belt to form a trough. [2.21]

in-service light indicator. A light used to indicate that a timing device is in operation. [5.55]

increasing-load test. The normal basic performance test for a scale in which observations are made as increments of test load are successively added to the load-receiving element of the scale. [2.20]

increment. The value of the smallest change in value that can be indicated or recorded by a digital device in normal operation. [1.10]

index of an indicator. The particular portion of an indicator that is directly utilized in making a reading. [1.10]

indicating element. An element incorporated in a weighing or measuring device by means of which its performance relative to quantity or money value is "read" from the device itself as, for example, an index-and-graduated-scale combination, a weighbeam-and-poise combination, a digital indicator, and the like. (Also see "primary indicating or recording element.") [1.10]

indicator, balance. See "balance indicator." [2.20]

initial zero-setting mechanism. Automatic means provided to set the indication to zero at the time the instrument is switched on and before it is ready for use. [2.20]
(Added 1990)

initial distance or time interval. The interval corresponding to the initial money drop. [5.54]

interval, graduated. See "graduated interval." [1.10]

interval, clear, between graduations. See "clear interval between graduations." [1.10]

J

jewelers' scale. One adapted to weighing gems and precious metals. [2.20]

K

kind of grain. Corn as distinguished from soybeans as distinguished from wheat, etc. [5.56]

L

label. A printed ticket, to be attached to a package, produced by a printer that is a part of a prepackaging scale or that is an auxiliary device. [2.20]

large-delivery device. Devices used primarily for single deliveries greater than 200 gallons, 2000 pounds, 20 000 cubic feet, 2 000 liters, or 2 000 kilograms. [3.34]

laundry-drier timer. A timer used in conjunction with a coin-operated device to measure the period of time that a laundry drier is in operation. [5.55]

liquefied petroleum gas vapor-measuring device. A system including a mechanism or device of the meter type, equipped with a totalizing index, designed to measure and deliver liquefied petroleum gas in the vapor state by definite volumes, and generally installed in a permanent location. The meters are similar in construction and operation to the conventional natural- and manufactured-gas meters. [3.32]

liquefied petroleum gas. A petroleum product composed predominantly of any of the following hydrocarbons or mixtures thereof: propane, propylene, butanes (normal butane or isobutane), and butylenes. [3.32, 3.33]

liquefied petroleum gas liquid-measuring device. A system including a mechanism or machine of the meter type designed to measure and deliver liquefied petroleum gas in the liquid state by a definite quantity, whether installed in a permanent location or mounted on a vehicle. Means may or may not be provided to indicate automatically, for one of a series of unit prices, the total money value of the liquid measured. [3.33]
(Amended 1987)

liquid volume correction factor. A correction factor used to adjust the liquid volume of a cryogenic product at the time of measurement to the liquid volume at NBP. [3.34]

liquid-fuel device. A device designed for the measurement and delivery of liquid fuels. [3.30]

liquid-measuring device. A mechanism or machine designed to measure and deliver liquid by definite volume. Means may or may not be provided to indicate automatically, for one of a series of unit prices, the total money value of the liquid measured, or to make deliveries corresponding to specific money values at a definite unit price. [3.30]

liquid fuel. Any liquid used for fuel purposes, that is, as a fuel, including motor fuel. [3.30]

livestock scale. A scale equipped with stock racks and gates and adapted to weighing livestock standing on the scale platform. [2.20]
(Amended 1989)

load-receiving element. That element of a scale that is designed to receive the load to be weighed; for example, platform, deck, rail, hopper, platter, plate, scoop. [2.20]

load cell. A device, whether electric, hydraulic, or pneumatic, that produces a signal proportional to the load applied. [2.20]

load cell verification interval (v). The load cell interval, expressed in units of mass, used in the test of the load cell for accuracy classification. [2.20, 2.21]
(Added 1996)

loading point. The location at which material to be conveyed is applied to the conveyor. [2.21]

low-flame test. A test simulating extremely low-flow rates such as caused by pilot lights. [3.33]

lubricant device. A device designed for the measurement and delivery of liquid lubricants, including, but not limited to, heavy gear lubricants and automatic transmission fluids (automotive). [3.30]

M

m^3/h. Cubic meters per hour. [3.33]

main-weighbeam elements. The combination of a main bar and its fractional bar, or a main bar alone if no fractional bar is associated with it. [2.20]

main bar. A principal weighbeam bar, usually of relatively large capacity as compared with other bars of the same weighbeam. (On an automatic-indicating scale equipped with a weighbeam, the main weighbeam bar is frequently called the "capacity bar.") [2.20]

main graduation. A graduation defining the primary or principal subdivisions of a graduated series. (Also see "graduation.") [1.10]

manual zero-setting mechanism. Nonautomatic means provided to attain a zero balance indication by the direct operation of a control. [2.20]

manufactured device. Any commercial weighing or measuring device shipped as new from the original equipment manufacturer. [1.10]
(Amended 2001)

mass flow meter. A device that measures the mass of a product flowing through the system. The mass measurement may be determined directly from the effects of mass on the sensing unit or may be inferred by measuring the properties of the product, such as the volume, density, temperature, or pressure, and displaying the quantity in mass units.
[3.30, 3.32]

master meter test method. A method of testing milk tanks that utilizes an approved master meter system for measuring test liquid removed from or introduced into the tank. [4.43]

master weight totalizer. An indicating element used with a belt conveyor scale to indicate the weight of material that was passed over the scale. The master weight totalizer is a primary indicating element of the belt-conveyor scale. [2.21]

material test. The test of a belt-conveyor scale using material (preferably that for which the device is normally used) that has been weighed to an accuracy of 0.1 percent. [2.21]
(Amended 1989)

maximum capacity. The largest load that may be accurately weighed. [2.24]
(Added 1999)

maximum cargo load. The maximum cargo load for trucks is the difference between the manufacturer's rated gross vehicle weight and the actual weight of the vehicle having no cargo load. [5.53]

meter register. An observation index for the cumulative reading of the gas flow through the meter. In addition there are one or two proving circles in which one revolution of the test hand represents 1/2, 1, 2, 5, or 10 cubic feet, or 0.025, 0.05, 0.1, 0.2, or 0.25 cubic meter, depending on meter size. If two proving circles are present, the circle representing the smallest volume per revolution is referred to as the "leak-test circle." [3.33]

metrological integrity (of a device). The design, features, operation, installation, or use of a device that facilitates (1) the accuracy and validity of a measurement or transaction, (2) compliance of the device with weights and measures requirements, or (3) the suitability of the device for a given application. [1.10, 2.20]
(Added 1993)

minimum capacity. The smallest load that may be accurately weighed. The weighing results may be subject to excessive error if used below this value. [2.24]
(Added 1999)

minimum totalized load. The least amount of weight for which the scale is considered to be performing accurately. [2.21]

minimum tolerances. Minimum tolerances are the smallest tolerance values that can be applied to a scale. Minimum tolerances are determined on the basis of the value of the minimum graduated interval or the nominal or reading face capacity of the scale. (See also definition for basic tolerances.) [2.20]

minimum clear interval. The shortest distance between adjacent graduations when the graduations are not parallel. (Also see "clear interval.") [3.30]

minimum delivery. The least amount of weight that is to be delivered as a single weighment by a belt-conveyor scale system in normal use. [2.21]

moisture content (wet basis). The mass of water in a grain or seed sample (determined by the reference method) divided by the mass of the grain or seed sample expressed as a percentage (%). [5.56]

money-operated type. A device designed to be released for service by the insertion of money, or to be actuated by the insertion of money to make deliveries of product. [1.10]

money drop. An increment of fare indication. The "initial money drop" is the first increment of fare indication following activation of the taximeter. [5.54]

motor-fuel device or motor-fuel dispenser or retail motor-fuel device. A device designed for the measurement and delivery of liquids used as fuel for internal-combustion engines. The term "motor-fuel dispenser" means the same as "motor-fuel device"; the term "retail motor-fuel device" applies to a unique category of device (see definition of "retail device"). [3.30]

motor fuel. Liquid used as fuel for internal-combustion engines. [3.30]

multi-interval scale. A scale having one weighing range which is divided into partial weighing ranges, each with different scale intervals, with the weighing range determined automatically according to the load applied, both on increasing and decreasing loads. [2.20]
(Added 1995)

multi-revolution scale. An automatic-indicating scale having a nominal capacity that is a multiple of the reading-face capacity and that is achieved by more than one complete revolution of the indicator. [2.20]

multiple cell application load cell. A load cell intended for use in a weighing system which incorporates more than one load cell. A multiple cell application load cell is designated with the letter "M" or the term "Multiple." (See also "single cell application load cell.") [2.20]
(Added 1999)

multiple of a scale. In general, the multiplying power of the entire system of levers or other basic weighing elements. (On a beam scale, the multiple of the scale is the number of pounds on the load-receiving element that will be counterpoised by 1 pound applied to the tip pivot of the weighbeam.) [2.20]

multiple range scale. A scale having two or more weighing ranges with different maximum capacities and different scale intervals for the same load receptor, each range extending from zero to its maximum capacity. [2.20]
(Added 1995)

multiple-tariff taximeter. One that may be set to calculate fares at any one of two or more rates. [5.54]

multiple. An integral multiple; that is, a result obtained by multiplying by a whole number. (Also see "multiple of a scale.") [1.10]

N

natural gas. A gaseous fuel, composed primarily of methane, that is suitable for compression and dispensing into a fuel storage container(s) for use as an engine fuel. [3.37]
(Added 1994)

NBP. Normal boiling point of a cryogenic liquid at 14.696 lb/in^2 absolute. [3.34]

n_{max} (maximum number of scale divisions). The maximum number of scale divisions for which a main element or load cell complies with the applicable requirements. The maximum number of scale divisions permitted for an installation is limited to the lowest n_{max} marked on the scale indicating element, weighing element, or load cell. [2.20, 2.21, 2.24]
(Added 1997)

no-load reference value. A positive weight value indication with no load in the load-receiving element (hopper) of the scale. (Used with automatic bulk-weighing systems and certain single draft, manually-operated receiving hopper scales installed below grade and used to receive grain.) [2.20]

nominal capacity. The nominal capacity of a scale is (a) the largest weight indication that can be obtained by the use of all of the reading or recording elements in combination, including the amount represented by any removable weights furnished or ordinarily furnished with the scale, but excluding the amount represented by any extra removable weights not ordinarily furnished with the scale, and excluding also the capacity of any auxiliary weighing attachment not contemplated by the original design of the scale, and excluding any fractional bar with a capacity less than 2-1/2 percent of the sum of the capacities of the remaining reading elements, or (b) the capacity marked on the scale by the manufacturer, whichever is less. (Also see "nominal capacity, batching scale"; "nominal capacity, hopper scale.") [2.20]

nominal capacity, batching scale. The nominal capacity of a batching scale is the capacity as marked on the scale by the scale manufacturer, or the sum of the products of the volume of each of the individual hoppers, in terms of cubic feet, times the weight per cubic foot of the heaviest material weighed in each hopper, whichever is less. [2.20]

nominal capacity, hopper scale. The nominal capacity of a hopper scale is the capacity as marked on the scale by the scale manufacturer, or the product of the volume of the hopper in bushels or cubic feet times the maximum weight per bushel or cubic foot, as the case may be, of the commodity normally weighed, whichever is less. [2.20]

nominal. Refers to "intended" or "named" or "stated," as opposed to "actual." For example, the "nominal" value of some-thing is the value that it is supposed or intended to have, the value that it is claimed or stated to have, or the value by which it is commonly known. Thus, "1-pound weight," "1-gallon measure," "1-yard indication," and "500-pound scale" are statements of nominal values; corresponding actual values may be greater or lesser. (See nominal capacity of a scale.) [1.10]

nonretroactive. "Nonretroactive" requirements are enforceable after the effective date for:

1. devices manufactured within a State after the effective date;

2. both new and used devices brought into a State after the effective date; and

3. devices used in noncommercial applications which are placed into commercial use after the effective date.

Nonretroactive requirements are not enforceable with respect to devices that are in commercial service in the State as of the effective date or to new equipment in the stock of a manufacturer or a dealer in the State as of the effective date. *(Nonretroactive requirements are printed in italic type.)* [1.10]
(Amended 1989)

nose-iron. A slide-mounted, manually-adjustable pivot assembly for changing the multiple of a lever. [2.20]

notes. A section included in each of a number of codes, containing instructions, pertinent directives, and other specific information pertaining to the testing of devices. Notes are primarily directed to weights and measures officials. [1.10]

NTP density and volume correction factor. A correction factor used to adjust the liquid volume of a cryogenic product at the time of measurement to the gas equivalent at NTP. [3.34]

NTP. Normal temperature of 21 °C (70 °F) and pressure of 101.325 kPa (14.696 lb/in^2 absolute) respectively. [3.34]

O

odometer. A device that automatically indicates the total distance traveled by a vehicle. For the purpose of this code, this definition includes hub odometers, cable-driven odometers, and the distance-indicating or odometer portions of "speedometer" assemblies for automotive vehicles. [5.53]

official grain samples. Grain or seed used by the official as the official transfer standard from the reference standard method to test the accuracy and precision of grain moisture meters. [5.56]

official with statutory authority. The representative of the jurisdiction(s) responsible for certifying the accuracy of the device. [2.20, 2.21, 2.22]
(Added 1991)

operating tire pressure. The pressure in a tire immediately after a vehicle has been driven for at least 5 miles or 8 kilometers. [5.53, 5.54]

over-and-under indicator. An automatic-indicating element incorporated in or attached to a scale and comprising an indicator and a graduated scale with a central or intermediate "zero" graduation and a limited range of weight graduations on either side of the zero graduation, for indicating weights greater than and less than the predetermined values for which other elements of the scale may be set. (A scale having an over-and-under indicator is classed as an automatic-indicating scale.) [2.20]

overregistration and underregistration. When an instrument or device is of such a character that it indicates or records values as a result of its operation, its error is said to be in the direction of overregistration or underregistration, depending upon whether the indications are, respectively, greater or less than hey should be. Examples of devices having errors of "overregistration" are: a fabric-measuring device that indicates more than the true length of material passed through it; and a liquid-measuring device that indicates more than the true amount of the liquid delivered by the device. Examples of devices having errors of "under-registration" are: a meter that indicates less than the true amount of product that it delivers; and a weighing scale that indicates or records less than the true weight of the applied load. [1.10]

P

parallax. The apparent displacement, or apparent difference in height or width, of a graduation or other object with respect to a fixed reference, as viewed from different points. [1.10]

parking meter. A coin-operated device for measuring parking time for vehicles. [5.55]

passenger vehicles. Vehicles such as automobiles, recreational vehicles, limousines, ambulances, and hearses. [5.53]

performance requirements. Performance requirements include all tolerance requirements and, in the case of nonautomatic-indicating scales, sensitivity requirements (SR). (See definitions for "tolerance" and "sensitivity requirement".) [1.10]

point-of-sale system. An assembly of elements including a weighing or measuring element, an indicating element, and a recording element (and may also be equipped with a "scanner") used to complete a direct sales transaction.
[2.20, 3.30, 3.32, 3.37]
(Added 1986) (Amended 1997)

poise. A movable weight mounted upon or suspended from a weighbeam bar and used in combination with graduations, and frequently with notches, on the bar to indicate weight values. (A suspended poise is commonly called a "hanging poise".) [2.20]

postal scale. A scale (usually a computing scale) designed for use to determine shipping weight or delivery charges for letters or parcels delivered by the U.S. Postal Service or private shipping companies. A weight classifier may be used as a postal scale. [2.20]
(Added 1987)

prepackaging scale. A computing scale specially designed for putting up packages of random weights in advance of sale. [2.20]

prescription scale. A scale or balance adapted to weighing the ingredients of medicinal and other formulas prescribed by physicians and others and used or intended to be used in the ordinary trade of pharmacists. [2.20]

pressure type (device). A type of device designed for operation with the liquid under artificially produced pressure. [3.30]

primary indicating or recording elements. The term "primary" is applied to those principal indicating (visual) elements and recording elements that are designed to, or may, be used by the operator in the normal commercial use of a device. The term "primary" is applied to any element or elements that may be the determining factor in arriving at the sale representation when the device is used commercially. (Examples of primary elements are the visual indicators for meters or scales not equipped with ticket printers or other recording elements and both the visual indicators and the ticket printers or other recording elements for meters or scales so equipped.) The term "primary" is not applied to such auxiliary elements as, for example, the totalizing register or predetermined-stop mechanism on a meter or the means for producing a running record of successive weighing operations, these elements being supplementary to those that are the determining factors in sales representations of individual deliveries or weights. (See "indicating element" and "recording element".) [1.10]

prover oil. A light oil of low vapor pressure used as a sealing medium in bell provers, cubic-foot bottles, and portable cubic-foot standards. [3.33]

proving indicator. The test hand or pointer of the proving or leak-test circle on the meter register or index. [3.33]

prover method. A method of testing milk tanks that utilizes approved volumetric prover(s) for measuring the test liquid removed from or introduced into the tank. [4.43]
(Amended 2002)

R

"r" factor. A computation for determining the suitability of a vehicle scale for weighing vehicles with varying axle configurations. The factor was derived by dividing the weights in FHWA Federal Highway Bridge Gross Weight Table B by 34 000 lbs. (The resultant factors contained in Table UR.3.2.1.) [2.20]
(Added 1997)

radio frequency interference (RFI). Radio frequency interference is a type of electrical disturbance that, when introduced into electronic and electrical circuits, may cause deviations from the normally expected performance. [1.10]

ranges, weight. See "weight ranges." [2.20]

rated scale capacity. That value representing the weight that can be delivered by the device in one hour. [2.21]

rated capacity. The rate of flow in cubic meters per hour of a hydrocarbon gas vapor-measuring device as recommended by the manufacturer. This rate of flow should cause a pressure drop across the meter not exceeding 1/2-inch water column. [3.33]

ratio test. A test to determine the accuracy with which the actual multiple of a scale agrees with its designed multiple. This test is used for scales employing counterpoise weights and is made with standard test weights substituted in all cases for the weights commercially used on the scale. (It is appropriate to use this test for some scales not employing counterpoise weights.) [2.20]

reading-face capacity. The largest value that may be indicated on the reading face, exclusive of the application or addition of any supplemental or accessory elements. [1.10]

reading face. That portion of an automatic-indicating weighing or measuring device that gives a visible indication of the quantity weighed or measured. A reading face may include an indicator and a series of graduations or may present values digitally, and may also provide money-value indications. [1.10]

recorded representation. The printed, embossed, or other representation that is recorded as a quantity by a weighing or measuring device. [1.10]

recording element. An element incorporated in a weighing or measuring device by means of which its performance relative to quantity or money value is permanently recorded on a tape, ticket, card, or the like, in the form of a printed, stamped, punched, or perforated representation. [1.10, 2.21]

recording scale. One on which the weights of applied loads may be permanently recorded on a tape, ticket, card, or the like in the form of a printed, stamped, punched, or perforated representation. [2.20]

reference weight car. A railroad car weighed on a scale for temporary use as a mass standard over a short period of time (typically, the time required to test one scale) as part of a test train.

Note: A test weight car that is representative of the types of cars typically weighed on the scale under test may be used wherever reference weight cars are specified. [2.20]
(Added 1991)

remanufactured device. A device that is disassembled, checked for wear, parts replaced or fixed, reassembled and made to operate like a new device of the same type. [1.10]
(Added 2001)

remanufactured element. An element that is disassembled, checked for wear, parts replaced or fixed, reassembled and made to operate like a new element of the same type. [1.10]
(Added 2001)

remote configuration capability. The ability to adjust a weighing or measuring device or change its sealable parameters from or through some other device that is not itself necessary to the operation of the weighing or measuring device or is not a permanent part of that device. [2.20, 3.30]
(Added 1993)

repaired device. A device to which work is performed that brings the device back into proper operating condition. [1.10]
(Added 2001)

repaired element. An element to which work is performed that brings the element back into proper operating condition. [1.10]
(Added 2001)

retail device. A device used for:

single deliveries of less than 100 gallons,

retail deliveries of motor fuels to individual highway vehicles, or

single deliveries of liquefied petroleum gas for domestic use and liquified petroleum gas or liquid anhydrous ammonia for nonresale use. [3.32]
(Amended 1987)

retroactive. "Retroactive" requirements are enforceable with respect to all equipment. Retroactive requirements are printed herein in upright Roman type. (Also see "nonretroactive.") [1.10]

road test. A distance test, over a measured course, of a complete taximeter assembly when installed on a vehicle, the mechanism being actuated as a result of vehicle travel. [5.53]

rolling circumference. The rolling circumference is the straight line distance traveled per revolution of the wheel (or wheels) that actuates the taximeter or odometer. If more than one wheel actuates the taximeter or odometer, the rolling circumference is the verage distance traveled per revolution of the actuating wheels. [5.53, 5.54]

S

scale division, number of (n). Quotient of the capacity divided by the value of the verification scale division: [2.20]

$$n = \frac{\text{Capacity}}{e}$$

scale division, value of (d). The value of the scale division, expressed in units of mass, is the smallest subdivision of the scale for analog indication or the difference between two consecutively indicated or printed values for digital indication or printing. (Also see "verification scale division".) [2.20]

scale section. A part of a vehicle, axle-load, livestock, or railway track scale consisting of two main load supports, usually transverse to the direction in which the load is applied. [2.20]

scale. See specific type of scale. [2.20]

seal. See "approval seal," "security seal". [1.10]

section capacity. The section capacity of a scale is the maximum live load that may be divided equally on the load pivots or load cells of a section.
(Added 2001)

section test. A shift test in which the test load is applied over individual sections of the scale. This test is conducted to disclose the weighing performance of individual sections, since scale capacity test loads are not always available and loads weighed are not always distributed evenly over all main load supports. [2.20]

security means. A method used to prevent access by other than qualified personnel, or to indicate that access has been made to certain parts of a scale that affect the performance of the device. [2.21]

security seal. A uniquely identifiable physical seal, such as a lead-and-wire seal or other type of locking seal, a pressure-sensitive seal sufficiently permanent to reveal its removal, or similar apparatus attached to a weighing or measuring device for protection against or indication of access to adjustment. (Also see "approval seal".) [1.10]
(Amended 1994)

selector-type. A system of indication or recording in which the mechanism selects, by means of a ratchet-and-pawl combination or by other means, one or the other of any two successive values that can be indicated or recorded. [1.10]

semi-automatic zero-setting mechanism. Automatic means provided to attain a direct zero balance indication requiring a single initiation by an operator. [2.20]

sensitivity requirement (SR). A performance requirement for a nonautomatic-indicating scale; specifically, the minimum change in the position of rest of the indicating element or elements of the scale in response to the increase or decrease, by a specified amount, of the test load on the load-receiving element of the scale. [2.20]

sensitivity (of a nonautomatic-indicating scale). The value of the test load on the load-receiving element of the scale that will produce a specified minimum change in the position of rest of the indicating element or elements of the scale. [2.20]

shift test. A test intended to disclose the weighing performance of a scale under off-center loading. [2.20]

side. That portion of a pump or dispenser which faces the consumer during the normal delivery of product. [3.30]
(Added 1987)

simulated-road test. A distance test during which the taximeter or odometer may be actuated by some means other than road travel. The distance traveled is either measured by a properly calibrated roller device or computed from rolling circumference and wheel-turn data. [5.53, 5.54]

simulated test. A test using artificial means of loading the scale to determine the performance of a belt-conveyor scale. [2.21]

single cell application load cell. A load cell intended for use in a weighing system which incorporates one or more load cells. A single cell application load cell is designated with the letter "S" or the term "Single." (See also "multiple cell application load cell.") [2.20]
(Added 1999)

single-tariff taximeter. One that calculates fares at a single rate only. [5.54]

skirting. Stationary side boards or sections of belt conveyor attached to the conveyor support frame or other stationary support to prevent the bulk material from falling off the side of the belt. [2.21]

slow-flow meter. A retail device designed for the measurement, at very slow rates (less than 10 gallons per hour), of liquid fuels at individual domestic installations. [3.30]

small-delivery device. Any device other than a large-delivery device. [3.34]

span (structural). The distance between adjoining sections of a scale. [2.20]
(Added 1988)

specification. A requirement usually dealing with the design, construction, or marking of a weighing or measuring device. Specifications are directed primarily to the manufacturers of devices. [1.10]

static monorail weighing system. A weighing system in which the load being applied is stationary during the weighing operation. [2.20]
(Added 1999)

strain-load test. The test of a scale beginning with the scale under load and applying known test weights to determine accuracy over a portion of the weighing range. The scale errors for a strain-load test are the errors observed for the known test loads only. The tolerances to be applied are based on the known test load used for each error that is determined.
[2.20, 2.22]

subordinate graduation. Any graduation other than a main graduation. (Also see "graduation".) [1.10]

subsequent distance or time intervals. The intervals corresponding to money drops following the initial money drop. [5.54]

surface gauge. A combination of (1) a stationary indicator, and (2) a movable, graduated element designed to be brought into contact with the surface of the liquid from above. [4.43]

T

tail pulley. The pulley at the opposite end of the conveyor from the head pulley. [2.21]

take-up. A device to provide sufficient tension in a conveyor belt so that the belt will be positively driven by the drive pulley. A counter-weighted take-up consists of a pulley free to move in either the vertical or horizontal direction with dead weights applied to the pulley shaft to provide the tension required. [2.21]

tare-weighbeam elements. The combination of a tare bar and its fractional bar, or a tare bar alone if no fractional bar is associated with it. [2.20]

tare mechanism. A mechanism (including a tare bar) designed for determining or balancing out the weight of packaging material, containers, vehicles, or other materials that are not intended to be included in net weight determinations. [2.20]

taximeter. A device that automatically calculates, at a predetermined rate or rates, and indicates the charge for hire of a vehicle. [5.54]

testing. An operation consisting of a series of volumetric determinations made to verify the accuracy of the volume chart that was developed by gauging. [4.43]

test liquid. The liquid used during the test of a device. [3.30]

test chain. A device used for simulated tests consisting of a series of rollers or wheels linked together in such a manner as to assure uniformity of weight and freedom of motion to reduce wear, with consequent loss of weight, to a minimum. [2.21]

test train. A train consisting of or including reference weight cars and used to test coupled-in-motion railway track scales. The reference weight cars may be placed consecutively or distributed in different places within a train. [2.20]
(Added 1990) (Amended 1991)

test weight car. A railroad car designed to be a stable mass standard to test railway track scales. The test weight car may be one of the following types: a self-contained composite car, a self-propelled car, or a standard rail car. [2.20]
(Added 1991)

time recorder. A clock-operated mechanism designed to record the time of day. Examples of time recorders are those used in parking garages to record the "in" and "out" time of day for parked vehicles. [5.55]

timing device. A device used to measure the time during which a particular paid-for service is dispensed. Examples of timing devices are laundry driers, car-wash timers, parking meters, and parking-garage clocks and recorders. [5.55]

tolerance. A value fixing the limit of allowable error or departure from true performance or value. (See also "basic tolerances".) [1.10]

training idlers. Idlers of special design or mounting intended to shift the belt sideways on the conveyor to assure the belt is centered on the conveying idlers. [2.21]

transfer standard. A measurement system designed for use in proving and testing cryogenic liquid-measuring devices. [3.34]

tripper. A device for unloading a belt conveyor at a point between the loading point and the head pulley. [2.21]

U

uncoupled-in-motion railroad weighing system. A device and related installation characteristics consisting of (1) the associated approach trackage, (2) the scale (i.e., the weighing element, the load-receiving element, and the indicating element with its software), and (3) the exit trackage which permit the weighing of railroad cars uncoupled in motion. [2.20]
(Added 1993)

underregistration. See "overregistration" and "under-registration." [1.10]

unit price. The price at which the product is being sold and expressed in whole units of measurement. [3.30]
(Added 1992)

unit weight. One contained within the housing of an automatic-indicating scale and mechanically applied to and removed from the mechanism. The application of a unit weight will increase the range of automatic indication, normally in increments equal to the reading-face capacity. [2.20]

unit train. A unit train is defined as a number of contiguous cars carrying a single commodity from one consignor to one consignee. The number of cars is determined by agreement among the consignor, consignee, and the operating railroad. [2.20]

user requirement. A requirement dealing with the selection, installation, use, or maintenance of a weighing or measuring device. User requirements are directed primarily to the users of devices. [1.10]

usual and customary. Commonly or ordinarily found in practice or in the normal course of events and in accordance with established practices. [1.10]

V

value of minimum graduated interval. The value represented by the interval from the center of one graduation to the center of the succeeding graduation. Also, the increment between successive recorded values. (Also see "graduated interval".) [1.10]

vehicle on-board weighing system. A weighing system designed as an integral part of or attached to the frame, chassis, lifting mechanism, or bed of a vehicle, trailer, industrial truck, industrial tractor, or forklift truck. [2.20]
(Amended 1993)

vehicle scale. A scale adapted to weighing highway, farm, or other large industrial vehicles (except railroad freight cars), loaded or unloaded. [2.20]

verification scale division, value of (e). A value, expressed in units of weight (mass) and specified by the manufacturer of a device, by which the tolerance values and the accuracy class applicable to the device are determined. The verification scale division is applied to all scales, in particular to ungraduated devices since they have no graduations. The verification scale division, e, may be different from the displayed scale division, d, for certain other devices used for weight classifying or weighing in predetermined amounts, and certain other Class I and II scales. [2.20]

visible type. A type of device in which the measurement takes place in a see-through glass measuring chamber. [3.30]

v_{min} (minimum load cell verification interval). The smallest load cell verification interval, *expressed in units of mass** into which the load cell measuring range can be divided.
[2.20, 2.21, 2.24]
*[*Nonretroactive as of January 1, 2001]*
(Added 1996) (Amended 1999)

W

weighbeam. An element comprising one or more bars, equipped with movable poises or means for applying counterpoise weights or both. [2.20]

weighing element. That portion of a scale that supports the load-receiving element and transmits to the indicating element a signal or force resulting from the load applied to the load-receiving element. [2.20]
(Added 1988)

weighment. A single complete weighing operation. [2.20, 2.21]
(Added 1986)

weight, unit. See "unit weight." [2.20]

weight classifier. A digital scale that rounds weight values up to the next scale division. These scales usually have a verification scale division, e, that is smaller than the displayed scale division. [2.20]
(Added 1987)

weight ranges. Electrical or electro-mechanical elements incorporated in an automatic indicating scale through the application of which the range of automatic indication of the scale is increased, normally in increments equal to the reading-face capacity. [2.20]

wet basis. See "moisture content (wet basis)." [5.56]

wet hose. A discharge hose intended to be full of product at all times. [See "wet-hose type".] [3.30, 3.31, 3.38]
(Amended 2002)

wet-hose type. A type of device designed to be operated with the discharge hose full of product at all times. [See "wet hose".] [3.30, 3.32, 3.34, 3.37, 3.38]
(Amended 2002)

wheel-load weighers. Compact, self-contained, portable weighing elements specially adapted to determining the wheel loads or axle loads of vehicles on highways for the enforcement of highway weight laws only. [2.20]

wholesale device. Any device other than a retail device. [See "retail device".] [3.30, 3.32]

wing pulley. A pulley made of widely spaced metal bars in order to set up a vibration to shake loose material off the underside (return side) of the belt. [2.21]

Z

zero-load balance. A correct weight indication or representation of zero when there is no load on the load-receiving element. (See also "zero-load balance for an automatic-indicating scale," "zero-load balance for a nonautomatic-indicating scale," "zero-load balance for a recording scale".) [2.20]

zero-load balance, automatic-indicating scale. A condition in which the indicator is at rest at, or oscillates through approximately equal arcs on either side of, the zero graduation. [2.20]

zero-load balance, nonautomatic-indicating scale. A condition in which (a) the weighbeam is at rest at, or oscillates through approximately equal arcs above and below, the center of a trig loop; (b) the weighbeam or lever system is at rest at, or oscillates through approximately equal arcs above and below, a horizontal position or a position midway between limiting stops; or (c) the indicator of a balance indicator is at rest at, or oscillates through approximately equal arcs on either side of, the zero graduation.

zero-load balance for a recording scale. A condition in which the scale will record a representation of zero load. [2.20]

zero-load reference (belt-conveyor scales). A zero-load reference value represents no load on a moving conveyor belt. This value can be either; a number representing the electronic load cell output, a percentage of full scale capacity, or other reference value that accurately represents the no load condition of a moving conveyor belt. The no load reference value can only be updated after the completion of a zero load test. [2.21]
(Added 2002)

zero-setting mechanism. Means provided to attain a zero balance indication with no load on the load-receiving element. Three types of these mechanisms are: [2.20]

> **manual zero-setting mechanism.** Nonautomatic means provided to attain a zero balance indication by the direct operation of a control. [2.20]
>
> **semiautomatic zero-setting mechanism.** Automatic means provided to attain a direct zero balance indication requiring a single initiation by an operator. [2.20]
>
> **automatic zero-setting mechanism.** Automatic means provided to maintain zero balance indication without the intervention of an operator. [2.20]

zero-setting mechanism (belt-conveyor scale). A mechanism enabling zero totalization to be obtained over a whole number of belt revolutions. [2.21, 2.23]
(Added 2002)

zone of uncertainty. The zone between adjacent increments on a digital device in which the value of either of the adjacent increments may be displayed. [2.20]

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